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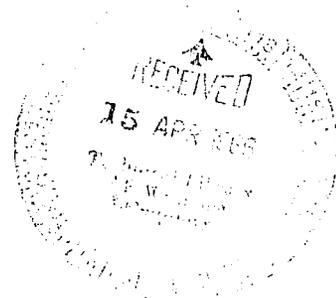
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**A STUDY OF THE OPTIMUM USE OF
LAND EXPOSED TO AIRCRAFT LANDING
AND TAKEOFF NOISE**

Prepared under Contract No. NAS 1-3697 by
ARDE, INC. & TOWN AND CITY, INC.
Paramus, N. J.
for Langley Research Center





A STUDY OF THE OPTIMUM USE OF LAND EXPOSED TO
AIRCRAFT LANDING AND TAKEOFF NOISE

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ABSTRACT

This report considers methods of alleviating the airport community noise problem by supplying guide lines for land use and building practices in noise affected areas near airports to reduce the area's sensitivity to noise. The report examines the legal, economic, and administrative aspects of such guidance.

Various governmental units and special authorities can control land use and building through their power to enact and enforce zoning ordinances, building codes and housing codes; to acquire property by eminent domain; and to levy taxes on property. The Federal government and to some extent, states, will provide technical and financial assistance to communities for planning and executing land use control programs.

The report considers the costs, technical possibilities, and limitations of noise-proof building construction to relieve the noise problem.

Actions by airport authorities in dealing with property owners in noise affected areas are reviewed. Procedures are presented for estimating the expected noise exposure around airports based on projected flight schedules. Desirable land uses near airports are defined and listed. These are:

- a. Open land uses involving few people;
- b. Inherently noisy activities not sensitive to additional noise;
- c. Indoor activities which may be protected by noise proof buildings; and
- d. Airport allied activities that have a strong incentive to be close to the airport.

A hypothetical airport community situation is analyzed to show, by example, how the various land use control and building noise proofing techniques can be applied, and the cost of such application.

The important elements of several significant law cases concerning noise affecting properties near airports are summarized.

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DESCRIPTION OF WORK PERFORMED

This study examines the application of existing powers, devices, and techniques available to local units of government for effecting the regulation of community development, to alleviate the problem of aircraft noise. Basic to this is an analysis of the sound-attenuating characteristics of conventional structures, methods of modifying those characteristics, and the relative cost of such modification. No attempt is here made to develop new concepts of techniques.

Information and data concerning the extent and characteristics of the airport noise problem were obtained from a literature research. In addition, data then being developed by other government agencies were made available by NASA. Field surveys were made of several major airports to observe existing conditions.

An extensive survey was made of the literature in the field of community planning, with respect to the powers and resources of local units of government relative to land use and development controls. In addition, the visits to the several major airports provided opportunities for interviews and discussion with airport and government officials and planners concerning local approaches to the problem. This permitted the assembly of a wide range of comments and evaluation of local experiences. Special attention was given to the multiplicity of governments involved in the various airport areas, the position of planning in the framework of local government, and the extent of intermunicipal or regional cooperation, especially with respect to comprehensive planning.

The range of interior sound levels acceptable for various human activities was derived from literature in the field of acoustics.

From literature in the construction and acoustic fields, a survey derived the sound transmission characteristics of various building materials and assemblies of materials. Possible modifications of construction to increase sound attenuation were examined and evaluated, and the associated costs were established.

As a final step, a hypothetical situation was created, in which to demonstrate the synthesis of the experience and information developed during the course of the previous phases of the work.

FINDINGS AND CONCLUSIONS

The community reaction to aircraft noise varies with the frequency of overflight, time of day, weather, season of the year, economic level of the community and other factors. No single approach to the noise problem will satisfy the specific conditions in all communities. In each instance, the specific solution to aircraft noise problems must be worked out by responsible agencies in the affected area, with due consideration to the extent of the area and the degree of its exposure to noise, the number of governmental jurisdictions involved, the objectives commonly agreed upon as attainable, the cost, and the potential for local cooperation and coordination in an area-wide program.

It is not feasible to change the outdoor noise environment near airports except by modification of the aircraft power plants, the operating procedures or the flight schedules. However, it is possible to reduce the sensitivity of the areas exposed to the noise by various devices.

A wide range of powers and devices is available to local units of government for the regulation and control of community development. Many of these may be employed to reduce the sensitivity of noise affected areas. These powers and devices include

- Planning
- Zoning
- Building Codes
- Eminent Domain
- Taxation
- Financial Aid
- Creation of special agencies

Intelligent advance planning, combined with appropriate zoning, with building codes based on performance standards, and with control over public utilities and streets, can be utilized to guide development around new airports into desirable patterns of compatible land use.

Land uses characterized by extensive open space and an absence of resident population are most suitable in areas exposed to the highest levels of aircraft noise. Industrial and commercial activities with a relatively high interior noise environment are suitable in areas exposed to lower levels of aircraft noise.

Most airports today are located in fully or partially developed areas whose land use patterns are usually not suited to the airport noise environment. In these areas zoning and

other regulations are too late to be of immediate benefit. Other measures must be taken to create a land use pattern under the takeoff and landing areas compatible with aircraft noise. The additional measures may include acquisition of avigation easements over private property, noise proofing of residential and other structures with or without special financial assistance to property owners, clearance of substandard areas and their redevelopment with compatible uses, and a variety of other actions.

In areas exposed to less than 100 PNdb the noise reduction accomplished by ordinary building construction is sufficient to create an acceptable residential interior noise environment when all windows are closed.

In areas exposed to between 100 and 110 PNdb it is feasible to effect an additional noise reduction of 10 decibels by structural modifications short of major reconstruction and thus achieve an acceptable interior noise level. The cost of such modifications will be about 10% of the base cost of the building.

In areas exposed to more than 110 PNdb, structural modifications short of major reconstruction will not be sufficient to produce a satisfactory interior noise environment.

The area affected by aircraft noise usually extends beyond the corporate limits of the municipality in which an airport is located. It is seldom possible for an individual municipality to take effective action to combat the noise problem by itself.

In many states, it is possible for municipalities to undertake cooperative programs, or to create regional agencies which can engage in planning and other activities on behalf of the entire area within its jurisdiction. In many instances, county government is in a position to perform such functions.

The existence of an area-wide official planning agency appears to be desirable and helpful. Even though it may have limited functions, it can contribute an impartial outlook and an environment conducive to cooperative action.

The Federal government, and to some extent, the states, have programs of technical and financial assistance for comprehensive community planning and for specific aspects of community development and redevelopment that can assist in the formulation and execution of solutions to aircraft noise problems relating to land use and development.

INTRODUCTION

A. BACKGROUND

The establishment and development of major airport facilities during the first several decades of civil aviation has been accompanied by unique problems related to aircraft noise. The noise is not so much a problem for the airport itself, but related more seriously to the land and buildings in the vicinity of the airport, especially under the takeoff and approach paths of aircraft. Early airports created little more than a minor nuisance to nearby residents. However, as airports become the center of a variety of economic activities, they attract many kinds of development - commercial, industrial and residential - which press close to the airport's boundaries, inhibiting expansion, and exposing additional population to aircraft noise.

The introduction of large four-engine piston aircraft requiring longer runways first opened up problems of airport expansion and development related to general community planning. These problems were not completely resolved by the time that jet aircraft came into general use. The noise produced by jet aircraft has different characteristics that make it more noticeable and which affect a larger territory than that of propeller aircraft. Indeed, in some localities, it has been claimed that the existence of an airport or its conversion to use by jets has depressed the value of land for a considerable distance, has destroyed the livability of nearby neighborhoods, and has reduced the municipal revenues from real estate taxes.

The prospect of commercial supersonic aircraft presents an additional challenge to those responsible for airport development and community planning. This is particularly true since supersonic aircraft are expected to use the same runways that accommodate current jet aircraft. Their noise exposures are expected to be similar to those of the current jet aircraft, but the areas affected will be different in shape.

B. PAST APPROACHES TO THE PROBLEM

The two major initial approaches to the problem of aircraft noise have been related primarily to the sources. They include:

1. Modification of aircraft power plant (engines) to reduce the amount of noise and to change the characteristics of the sound generated;
2. Modification of aircraft operating procedures to reduce the noise level beyond the airport boundaries and to limit the amount and frequency of exposure of affected land areas to overflight by jet aircraft.

The first approach is a function of the aircraft industry, which includes the designers and manufacturers of aircraft and engines. Development of the turbofan, for example, has reduced the amount of noise generated by engines to a considerable extent, but even this approach appears to have limits. The introduction into general service of smaller jet aircraft, having only two or three engines, has alleviated the problem somewhat, especially at the major airports. On the other hand, they make it possible to introduce jet service to smaller airports that hitherto did not receive jet aircraft, and it may well be that the noise problem will spread to additional areas. The development of aircraft capable of vertical or short takeoff and landing operation may be helpful in this respect.

The Federal Aviation Agency, the airlines, and the pilots have achieved some noise reduction through the modification of operating procedures. Operational procedures which are significant with respect to noise are: the rate of climb or descent of aircraft, and the application or reduction of power, which are under the direct control of the pilot, or which are more generally regulated by airline or FAA policies. The FAA control towers also regulate the direction of flights so as to spread them more generally over the urban area and thus reduce the exposure to noise of any given neighborhood. However, for the presently available aircraft, it would appear that this approach to aircraft noise control has been fully exploited.

C. PRESENT EFFORT

This report considers ways of achieving compatible land use patterns around airports by community action to regulate land use and development.

Previous studies of the airport noise problem have established procedures for estimating the anticipated noise exposure and have defined various categories of compatible land use. The present study, however, is the first one to explore the methods by which existing land uses may be modified and future developments may be regulated to achieve compatibility. This approach involves the entire range of factors - administrative, economic, and legal - related to community development.

It is the purpose of this paper to examine the ways and means available to municipalities and other local units of government to influence future land use patterns, to induce new construction that is compatible with the airport environment, and to modify existing structures and development patterns in a manner that will reduce the sensitivity of a community to aircraft noise. Thus, this information is applicable to existing airport situations as well as to areas in which airports are being planned for future construction.

Explicit in such an undertaking is the knowledge that there is no single approach which is applicable to all airport situations, and that the resolution of a complex development problem can and should be different in each community. The exploration of possible approaches and the examination of current successes and failures are, however, important to an effective dialogue which can lead to appropriate local decisions. It is to assist in the development of background material for such local discussions that this research program was undertaken.

TECHNIQUES FOR CONTROLLING LAND USE

A. INTRODUCTION

Control over the use of land, as that term is here employed, includes the powers and resources available to local government to regulate development, to induce such development by public agencies or private actions, to bring about the conversion or modification of existing land uses and structures, and to eliminate incompatible uses and replace them with other uses suitable for the noise environment. It relates to the power of governmental units to acquire and develop land, with or without the consent of the private owner, for public purposes, as well as to fiscal resources necessary to carry on programs of planning, acquisition, and development. The various factors involved are described below and discussed in greater detail on the following pages.

The legal authority for such regulation is a basic subject for examination. The discussion of zoning describes the sources of the power of government to regulate the ways in which privately owned land and buildings are used. Closely related to this is the use of building and housing codes, which affect the construction of structures and the arrangement and provision of certain amenities and safeguards for the public.

Land used for public purposes exercises considerable influence over the land held and used privately. Public services and facilities affect the usefulness and value of private holdings. The power of eminent domain, under which governments may acquire private property for public purposes, includes the right to acquire the full title to such property or a limited interest sufficient to meet the public necessity.

Fiscal resources include the power to levy taxes in support of government activities. The ways in which the tax power is used can affect private development to a considerable degree. The ability of public agencies to borrow funds also enters into the picture. In many instances, loans and grants are available from Federal and state governments for specific kinds of public functions. These have become an important source of support for the planning and execution of public works as well as for general community planning, and are examined in some detail.

The level of government appropriate to conduct various kinds of programs, as well as the relationships among various levels and types of governmental units, has a bearing on the approach to resolving the problems of aircraft noise. They are discussed under the heading "Administrative Organization".

All of the above relate to the mechanics of handling various elements of the problem. The remainder of the section sets forth an analysis of the physical factors and costs which must be considered in arriving at any solution. These include the determination of noise levels generated by aircraft in the environs of airports, interior noise levels acceptable to

the human ear under various situations, the acoustic qualities of buildings, and ways in which these qualities may be modified, the relative cost of such modification, and a listing of several categories of land use suitable for high noise levels.

B. SOURCES OF FUNDS

The Federal government and many states provide financial assistance in the form of loans and grants to local units of government for a variety of purposes. These relate to general community planning as well as to the planning and execution of a number of different kinds of public programs for specific functions, many of which can be brought to bear on the problem of aircraft noise. In addition to financial aid to public agencies for public action, several government assistance programs can be used directly or indirectly for private development programs.

1. General

The several State constitutions and the State legislative provisions for the establishment of subordinate levels of government carefully circumscribe the latter's financial powers and resources and reserve certain kinds of revenues to the State governments. As a result of the limitations on their ability to levy taxes and to borrow money most local jurisdictions are hampered in their efforts to institute desirable programs, and are, therefore, constantly forced to seek new sources of financial aid.

During the past fifty years Congress has authorized a wide variety of financial aid programs to enable the States and subordinate levels of government to provide specific services or facilities. In certain instances this assistance is for programs carried on at the State level; in others, the assistance is channeled to lower levels of government through State agencies; and in some instances, local agencies deal directly with the Federal sponsors of a program. In recent years a number of States have undertaken to assist municipalities with programs similar to those of Federal agencies which are either parallel and independent, or in direct support of the Federal programs. A list of activities for which Federal financial aid is available is presented below and discussed in detail thereafter.

A. Assistance for General Planning

- Comprehensive Planning for individual municipalities, counties, metropolitan areas, regions, and states. Funds to appropriate public agency through Urban Renewal Administration, Housing and Home Finance Agency (generally through a designated State agency) under Housing Act of 1954 as amended.

- Community Renewal Planning for municipalities, counties and metropolitan areas. Funds from Urban Renewal Administration Housing and Home Finance Agency to appropriate public agency under Housing Act of 1954 as amended.
- Metropolitan Area Transportation Planning. Funds to appropriate regional public agency from Bureau of Public Roads and Urban Renewal Administration under Highway Act of 1962 and Housing Act of 1954.

B. Assistance for Functional Planning

- Airport Planning
Funds to local public airport sponsor from Federal Aviation Agency (generally through State Aeronautics Department) under Federal Aid to Airports Act.
- Highway Planning
Funds to State Highway Departments from Bureau of Public Roads, Department of Commerce under Highway Act as amended.

C. Assistance for Design of Specific Projects

- Airport Facilities and Structures
Funds to local public sponsor from Federal Aviation Agency (through state aeronautics departments) under Federal Aid to Airports Act.
- Highways
Funds to state highway departments from Bureau of Public Roads, Department of Commerce under Highway Act of 1962.
- Other Public Works
Funds to municipalities from Community Facilities Administration, Housing and Home Finance Agency, under Housing Act of 1954 as amended.
- Urban Renewal Projects
Funds to appropriate municipal agencies from Urban Renewal Administration, Housing and Home Finance Agency under Housing Act of 1954 as amended.

D. Assistance for Land Acquisition

- Airports
Funds to local public sponsor from Federal Aviation Agency (through State Aeronautics Departments) under Federal Aid to Airports Act of 1964.

- Open Land
Funds to municipalities or appropriate metropolitan or regional public agency from Urban Renewal Administration Housing and Home Finance Agency.

E. Assistance for the Execution of Projects

- Airports
Funds to local public sponsor from FAA (through State Aeronautics Departments) under Federal Aid to Airports Act.
- Highways
Funds to state highway departments from Bureau of Public Roads, Department of Commerce under Highway Act.
- Public Works
Funds to municipalities from Community Facilities Administration, Housing and Home Finance Agency under Housing Act of 1954 as amended.
Funds to municipalities from Public Health Service and Department of Health, Education and Welfare (through State health departments) under Water Pollution Control Act.
- Urban Renewal
Funds to appropriate local public agency from Urban Renewal Administration, Housing and Home Finance Agency under Housing Act of 1951 as amended.
- Economic Development
Funds to appropriate state and local agencies from Small Business Administration, Department of Commerce under Area Redevelopment Act.

F. Assistance for Private Activity

- Mortgage Insurance for Residential Construction By Federal Housing Administration, Housing and Home Finance Agency.
- Reduction of the Cost of Land Through Urban Renewal Land available for private development from local public agencies under Urban Renewal Program.
- Assistance to Private Business Development companies by Small Business Administration, Department of Commerce.

While most Federal-aid programs pertain to specific functions and are restricted to a single level of government others are quite broad in scope, take into consideration many related factors and apply to a large geographic area. In the final analysis the determination

in any given area of the agency or level of government best suited to execute or coordinate the effort of inducing compatible land uses in the vicinity of an airport may well depend on the ability to satisfy the requirements for receiving the financial aid available from a higher government level.

In any discussion of financial aids available to local units of government it is important that the meaning of various frequently used terms be clearly understood. An advance of funds generally implies an eventual accounting of the project costs and full or partial repayment, with or without interest. A grant of funds is a contribution that is not expected to be repaid. A loan, on the other hand, is expected to be repaid over a specific period of time with or without interest. The matching of funds implies equal contributions from two parties, while the sharing of costs indicates other formulas for assigning costs among various parties. Some programs, of course, involve more than one of these various types of financial assistance.

2. Assistance for General Planning

a. Comprehensive Planning: According to the Advisory Commission on Intergovernmental Relations, comprehensive planning, at the community level, involves:

- (1) Developing and revising a land use plan;
- (2) Coordinating functional plans for transportation, public buildings, public utilities, park and recreation areas, urban renewal, capital improvements; and
- (3) Devising means of carrying out these plans through public and private actions that help produce growth and development in the urban area - i.e., the capital improvement program and budget, and zoning, sub-₁ division, and right-of-way reservation ordinances.

With some modification of the listed items, the above applies also to comprehensive planning as carried on at regional, metropolitan and State levels.

In order to encourage comprehensive land use planning at all levels of government and to provide a logical basis for coordinating various Federal-aid programs, Congress, in 1954, authorized the Local Planning Assistance Program² and placed its supervision with the Urban Renewal Administration (URA) of the Housing and Home Finance Agency (HHFA). Federal grants of funds amounting to two-thirds of the cost of conducting comprehensive planning programs of major elements thereof are authorized under this program. In depressed areas, as defined in the Area Redevelopment Act (ARA), the grant may be increased to three-quarters of the cost. Eligible recipients and the required scope of their activities are:

- (1). State planning agencies or other designated State agencies for the provision of planning assistance to municipalities or counties with a population of less than 50,000, or groups of municipalities in an urbanized area having an aggregate population of less than 50,000. Such municipalities or counties must have official planning agencies;
- (2). Official State, metropolitan, or regional planning agencies that are authorized by State or local laws or interstate compacts to perform metropolitan or regional comprehensive planning in areas with one or more cities having a population of more than 50,000;
- (3). Official State planning agencies performing comprehensive planning on a state-wide or interstate basis, for planning activities and for research and coordination related to such activities;
- (4). City, county, or other authorized planning agencies in areas under Section 5(a) of the Area Redevelopment Act, regardless of population, for performing the comprehensive planning elements of the required Overall Economic Development Plan;
- (5). Municipalities and counties in areas that have suffered substantial damage as the result of a catastrophe which the President has declared to be a disaster;
- (6). Official planning agencies for areas where rapid urbanization has resulted or is expected from the establishment or rapid expansion of a Federal installation.

Specific planning activities may be carried on by staff personnel, by consultants, or by a combination of both staff and consultants. The States of Connecticut, New York, and Pennsylvania contribute half of the non-Federal share of the cost of local programs; some States contribute the services of their planning staffs or otherwise supplement the funds available for local planning; while other States merely act as administrators of the program.

The desirability of conducting comprehensive planning at a higher level than the single municipality is given added impetus by the Highway Act of 1962³, which requires the establishment of a continuous program of comprehensive transportation planning on a metropolitan area basis as a pre-requisite for continued participation in the Federal-aid highway program after 1965. Legislation was also introduced in the 88th Congress to require at least a review by a metropolitan planning agency of all projects receiving Federal assistance in the various jurisdictions of a metropolitan area, but none of the measures to that end was adopted. However, some type of area-wide coordination of certain Federal programs is certainly desirable and will in time no doubt be effected.

b. Community Renewal Planning: The Community Renewal Program (CRP), also supervised by the URA, is closely related to comprehensive planning but assistance is restricted to agencies below the State level.⁴ The objective of this program is to provide

for: the identification of areas that are blighted, deteriorating, or deteriorated; the measurement of the nature and degree of blight and blighting factors within such areas; the determination of the financial, relocation, and other resources needed and available to rehabilitate or to redevelop such areas; the identification of potential urban renewal project areas and the preliminary determination of the types of renewal actions that are desirable; and the preparation of a schedule of urban renewal activities.

Grants amounting to two-thirds of the cost of conducting such studies are available to metropolitan, county, or municipal agencies which are authorized to enter into the necessary contractual arrangements, to undertake the planning work necessary to complete the CRP, and to execute a program of urban renewal actions. The preparation of simultaneous coordinated programs by two or more municipalities in a metropolitan area is encouraged; and, if all the local governing bodies agree to such a program, a single metropolitan agency may be authorized to prepare community renewal programs for the entire area.

Since a Community Renewal Plan is dependent upon general planning as a basis for sound decisions and since under the statutes the local governing body must certify that the CRP conforms to the comprehensive plan of the community, a comprehensive plan must be either completed or assured of completion by the time the CRP is completed. Furthermore, CRP programs can be approved only for those municipalities that have certified "workable programs" for community improvement. As the necessary certification may be granted upon a showing that the community is making steady progress toward completing the various elements of the workable program, the CRP itself may be used for studies of virtually all aspects of those elements except the comprehensive plan. Several States have already moved to provide assistance to their communities in the preparation of Community Renewal Plans. In New Jersey, for instance, the State, through the Division of State and Regional Planning of the Department of Conservation and Economic Development, contributes one-third of the non-Federal share of the costs. It also provides technical advice and assistance in the preparation of applications, the establishment of standards for the scope and content of CRP studies, and the selection of qualified planning personnel.

3. Assistance for Functional Planning

The Federal government provides grants and/or advances for general planning preliminary to detailed project planning for a variety of functions. Among those pertinent to the present topic are those for airport and highway planning.

a. Airport Planning: Under the 1964 amendments to the Federal Airport Act,⁵ the Federal Aviation Agency may make grants amounting to fifty per cent of the cost of developing "airport layout plans" based on approved advance planning and engineering proposals. Such a plan is defined in the legislation as:

...showing boundaries and proposed additions to all areas owned or controlled by the sponsor for airport purposes, the location and nature of existing and proposed airport facilities and structures, and the location on the airport of existing and proposed non-aviation areas and improvements thereon. ⁶

The Federal Airport Act was also amended in 1964 to provide for coordination between airport projects and local comprehensive planning, by requiring that:

...appropriate action, including the adoption of zoning laws, has been or will be taken, to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations including landing and take-off of aircraft; ⁷

In order to develop procedures for better coordination of airport planning with urban planning programs, the Urban Renewal Administration and the Federal Aviation Agency have established joint committees. Under current policy directives, URA grants may be used for basic studies relating airports to the comprehensive plans for an area, including surveys and projections of population and economic base, and land use and transportation plans, and for the review or preparation of land use controls, such as zoning, in the vicinity of airports. These grants cannot, however, be used for airport layout planning.

An additional requirement is an agreement between the airport sponsor and the planning agency in the area affected by the airport which provides for the coordination of their respective programs.

b. Highway Planning: Congress has authorized two programs to aid the States in highway planning and construction. The first is the older program of Federal grants for the construction and maintenance of the primary and secondary highway system including urban arterial highways.⁸ This is a matching program with allocations to the State Highway Departments according to a formula that takes into consideration such variables as population and area. The second, and newer program, relates to the Interstate Highway System that is expected to be completed by 1970 or shortly thereafter.⁹ Under this program the Federal grant to State Highway Departments amounts to ninety per cent of the costs, with an additional financial incentive for the elimination of advertising signs within a minimum distance of the highways. Under the Federal Highway law, one and one-half per cent of the annual appropriation for highways must be used for planning and research or else be forfeited. An additional amount equal to one-half per cent is available for the same purpose but on an optional basis. Where the State Highway Department and local

planning agencies agree to carry on combined highway and general planning programs, the urban planning assistance grants and the Federal-aid highway planning and research funds may be used jointly by State, local, and metropolitan planning agencies.

To implement the highway planning program, the URA and the Bureau of Public Roads have established joint committees, and their parent agencies, the HHFA and the Department of Commerce, have issued joint policy statements.

c. Other Programs: The Department of Health, Education and Welfare, the Department of Agriculture, the Public Health Service, and other Federal agencies also sponsor programs which pertain to comprehensive or functional planning. However, these generally relate to rural areas or to activities such as schools and hospitals which do not lend themselves to locations in the vicinity of major airports.

4. Assistance for Planning Specific Projects

A number of programs exist to provide funds for the detailed planning of specific structures and facilities but which do not simultaneously provide construction funds.

a. Airport Facilities and Structures: Federal grants may be made by the FAA to local public agencies sponsoring airports accepted for the National Airport Plan for the purpose of preparing plans which are designed to lead to project applications.¹⁰ The same matching formula is available as for general airport planning, but the items that may be included in such detailed facility plans are limited to those pertaining directly to aircraft operation, such as runways, taxiways, airfield lighting systems and navigational aids. The designs of other public facilities at airports may be covered by other programs described below.

b. Highway Design: Although the Federal-aid highway programs are generally structured so that the States are reimbursed to the extent of the Federal share of costs, it is possible under special circumstances to obtain advances from the Bureau of Public Roads, within the limits of matching or sharing formulae.¹¹

c. Public Works in General: The Community Facilities Administration of the Housing and Home Finance Agency is authorized to make advances to State and local public agencies to aid in the preparation of preliminary surveys and detailed construction drawings and specifications for all types of public works except public housing.¹² Such advances are limited to projects for which construction is planned within a reasonable period, and which conform to an approved State, regional, or local plan. Advances are not available under this program for projects covered by other Federal-aid programs. The advance is repayable, without interest, when construction begins from the funds available for executing the project. However, repayment is waived if construction is initiated as the result of a grant under the Public Works Acceleration Act. Although the primary purpose of this program is to maintain a current reserve of planned public works, the program helps to attain maximum efficiency and economy in planning and construction.

d. Urban Renewal Planning: To the extent required for detailed planning of individual urban renewal projects, the Urban Renewal Administration may make interest-free advances to local agencies authorized to plan and execute urban renewal activities. ¹³ The planning costs are then included with other costs of the project in the final accounting which determines the Federal and local sharing of the net costs of the project.

Similar advances are made for the preparation of a General Neighborhood Renewal Plan, in which the projected renewal activities pertain to a large area and it is both desirable and feasible to finance and execute the total program within a ten-year period as a series of related urban renewal projects. ¹⁴

In order to qualify for urban renewal assistance for either an individual project or a general neighborhood renewal program, a municipality must have a certified workable program as defined above. However, unlike the Community Renewal Program, the advance for urban renewal planning activities cannot be used for area-wide studies but must be expended on plans for specific projects.

5. Assistance for Land Acquisition

The acquisition of sites for various facilities and structures is generally included in the total project cost. There are several programs that have specific application to the acquisition of land or of easements or other rights in land

a. Airports: Grants from the Federal Aviation Agency may be obtained on a matching basis to acquire land needed for airport use, for clear zones, for navigational structures, and for easements or other rights in land as required to protect approach zones. ¹⁵ If the Administrator of the FAA determines that surplus real property is suitable or desirable for public airport use, the property may be transferred by the General Services Administration to a State or lesser government agency or institution without cost but with certain restrictions and limitations on its use or eventual disposition.

b. Open Land: State and subordinate public agencies may obtain grants from the Urban Renewal Administration of the HHFA to assist them in taking prompt action to preserve open-space land located within their jurisdiction that is essential to the proper long range development of an urban area. ¹⁶ The grant to a municipality may amount to twenty per cent of the cost of acquiring the full fee or other permanent interest in the land. However, where a public agency exercises open-space preservation responsibilities for an entire urban area, or a substantial part of one, the grant may be increased to thirty per cent of the cost. In several States, notably New Jersey, New York, and Wisconsin, there are similar programs under which municipalities receive grants from the States for acquiring and/or preserving open land for parks, recreation, and other purposes. ¹⁷

6. Assistance for the Execution of Projects

When general planning for municipalities and larger areas has been accomplished, and detailed plans have been prepared for specific facilities or functional systems, financial assistance may be available to public agencies for the execution of projects and for the construction of structures and facilities.

a. Airports: Matching grants are available from the Federal Aviation Agency for the construction of airports included in the National Airport Plan and for the construction of a limited range of structures and facilities essential to their operational safety, such as runways, taxiways, roads, lighting and utility systems.¹⁸ In special circumstances, the Federal grant may be as high as three-quarters of the cost. Thirty-three States make various kinds of assistance available to their subordinate governments, while thirteen States have formal programs under which they contribute to the local share of project costs.¹⁹

b. Highways: Matching grants are available from the Bureau of Public Roads to State Highway Departments for the construction and maintenance of the system of primary and secondary highways including urban arterial systems.²⁰ In most instances the balance is provided by the State alone, but in a few States municipalities must carry some part of the project costs in the form of local acquisition of needed rights-of-way or a direct cash contribution.

In connection with the Interstate Highway System the States generally provide all of their share of the costs which generally amount to ten per cent or less. In addition, many lower levels of government receive annual State grants for highway construction and maintenance according to various formulae that differ from State to State.

c. Public Works: For projects not otherwise covered by Federal aid programs and where reasonable financing is not otherwise available, the Community Facilities Administration of the HHFA makes loans to public agencies for the construction of essential public works.²¹ Participation in this program is limited to municipalities with a population of less than 50,000 and interest is charged at the rate of three and three-quarters per cent.

In labor surplus areas, however, and in redevelopment areas under the Area Redevelopment Act, the population limit is increased to 150,000 and the interest rate is reduced to three and one-half per cent. Also, in order to provide increased local employment as well as to meet long standing community needs for services and facilities, the Area Redevelopment Administration may authorize grants amounting to three-quarters of the cost of construction of essential public facilities.²² Such grants are available to those State and local public agencies which meet normal eligibility requirements of the individual Federal programs involved, as well as the requirements for participation in the ARA. As previously stated, under such conditions any advances for public works planning need not be repaid.

Another program for construction of public works is one sponsored by the Public Health Service of the Department of Health, Education and Welfare to assist in the elimination of stream pollution. Grants amounting to thirty per cent of the costs of a project may be made to local agencies, with an upper limit of \$600,000 to a single jurisdiction. Where such projects are undertaken by joint action of several municipalities, the maximum grant is \$2,400,000. A basic requirement for participation in the program is approval by a State water pollution control agency, which must have a Statewide program for abatement of pollution.²³ A number of states, including New York, offer technical as well as financial assistance to municipalities for such projects. Unique among the limitations of the program is its restriction to the planning and construction cost for major elements of sewerage systems, including the treatment plant and trunk sewers, interceptors and outfalls; however, the grants cannot be used for the acquisition of sites or rights of way for these facilities.

d. Urban Renewal: As described above, detailed planning for urban renewal projects may be carried on with the aid of an advance of funds from the Urban Renewal Administration, and in addition, the local urban renewal agency may obtain short-term loans to be used as working capital until revenue can be realized from the project.²⁴ Once the project is completed and an accounting made of all costs and revenues, the municipality receives a Federal grant amounting to two-thirds of the net cost of the project. In cities with a population of less than 50,000 and, in areas designated under the Area Redevelopment Act in cities with a population of 150,000 or less, the Federal grant is increased to three-quarters of the net project cost. The municipal share of project costs may be in the form of cash as well as in the form of public works and other improvements which serve the urban renewal area in whole or in part. Such public improvements may be eligible for advances for planning and/or loans for essential public works.

The Urban Renewal Administration also provides grants to reimburse the full amount expended by the local agency for relocation payments to families, individuals, and businesses displaced from an urban renewal area.

e. Economic Development: The Small Business Administration (SBA) may make loans to State and local Economic Development Companies to assist private economic development.²⁵ Loans equal to the total amount available from other resources may be made to State Development Companies for long term loans to small businesses. The Federal loans are for twenty years and carry five per cent interest. Loans may be made to State or local development companies for joint loans to private business. These may run for twenty-five years and carry five or five and one-half per cent interest. However, the SBA share of the loan may not exceed ninety per cent of the total, with a maximum of \$350,000; and the development company is generally required to provide twenty per cent of the total. In labor surplus areas, the interest rate for all of the above loan programs is reduced to four per cent.

7. Assistance for Private Activity

In addition to programs of financial assistance to public agencies for general planning and for the carrying out of projects, assistance is available to private individuals and agencies for certain activities that relate to land use modification. These include the positive and negative aspects of mortgage insurance available for residential construction, encouragement for the development of small business, and the possible reduction of land development or redevelopment costs in and near urban areas.

a. Mortgage Insurance for Residential Construction, Improvement, and Rehabilitation:

The Federal Housing Administration conducts an extensive program to assist in financing new, existing, and rehabilitated sales and rental housing, and in financing home improvements by insuring mortgages and loans. Loans are negotiated at prevailing or lower interest rates from local financial institutions; insurance is for varying percentages of the total cost, based on the type of project. Additionally, special programs are available for the encouragement of cooperative and condominium housing, housing for families of low and moderate income, housing for the elderly, nursing homes, housing in urban renewal areas, and housing for families displaced by governmental action.

Although the FHA must require conformity to official plans only for projects proposed in an urban renewal area, it normally cooperates with local planning and zoning authorities in every way possible to obtain compliance with local codes and ordinances, except where its standards are higher. Under current policies it may refuse to support a project exposed to excessive aircraft noise. ²⁶

b. Reduction of the Cost of Land Through Urban Renewal: The high cost of assembling developed land and clearing it for redevelopment is frequently an obstacle to private action. Under the urban renewal program, land in project areas may be sold or leased to private developers at its approximate market value for the re-use proposed. Under present policies there is considerable latitude in the kind of re-use with residential development eligible for special mortgage insurance under the programs of the FHA.

c. Assistance for Business Development: The Small Business Administration may make loans to small businesses either directly or in cooperation with private financial institutions and may make loans to private and public development agencies that in turn make loans to small business. Such loans may be used to finance the construction of commercial or industrial facilities. Especially favorable loans are available to small businesses that have been displaced by Federally-aided urban renewal, highway, and other programs, as well as to those that have suffered damage or destruction by storms, floods, or other major disasters.

Direct loans to small business may be no more than \$350,000, may run for up to ten years, and bear interest at five and one-half per cent (four per cent in labor surplus or Redevelopment Areas).

8. Combinations of Aids

An important element in the effective use of the many financial aid programs is the fact that there are numerous combinations of aid which may be employed. Thus, where Federal-aid interstate, primary, or secondary highways are planned in the vicinity of an airport, funds may be available from the Federal Aviation Agency, the Bureau of Public Roads, and the Urban Renewal Administration for planning the airport, the highway system serving it, and the general pattern of land uses around it. Where the specific highways fit into the Federal-aid system, grants are available for such highway construction. The urban planning assistance funds might be used to prepare standards and codes for acoustical protection of residences and other structures against the noise of fly-over; FHA insurance could cover mortgages or loans to finance required improvements to meet code requirements. FAA funds are available for acquiring easements or limited rights in occupied and undeveloped property along the approach and take-off flight path. Vacant lands near an airport that conform to a general plan for open spaces may be acquired with the assistance of the open-space grants from the URA. A Community Renewal Program, financed in part by the URA, enables a community or group of municipalities to study conditions in the area affected by airport noise with a view to effecting changes, where feasible, through urban renewal techniques. The URA advances funds for planning individual projects, provides loans to assist in executing the project, and makes grants covering a major portion of the net cost. A clear understanding of the manner in which these and related aid programs can be made to interact is critical to the long range resolution of conflicting land uses adjacent to major airports.

C. ADMINISTRATIVE ORGANIZATION

The multiplicity of jurisdictions usually involved in aircraft noise problems generated by a single airport requires that some kind of agency, higher than the individual municipality, should be available in the area to take a broad view of the problem as it relates to the area as a whole, and to develop and coordinate or execute whatever final solution is agreed upon. In each instance, the kind of agency and the level at which it operates must be decided upon in relation to the prevailing pattern of governments and their range of powers. Thus, it is possible that the state or county government may serve the function, or a special agency established for the purpose, either as an intermediate layer of government, as a cooperative activity of the local jurisdictions involved, or as a special district with separate and distinct powers and functions.

1. General

The problem of controlling land use around a major airport is complicated by the fact that the airport and the noise affected zone cover a tremendous area which is

frequently administered by many governmental agencies with various levels of authority. The area may cover municipalities, unincorporated areas, counties and sometimes even parts of two or more States.

Discussions with airport planning authorities have indicated that it is feasible to resolve the problem of noise affecting many jurisdictions provided there is adequate inter-municipal cooperation and an agency exists that has (a) a coordinating function which extends throughout the entire area; and (b) the reputation for impartiality toward all the constituent jurisdictions. This agency may be a county, a State or a special authority organized for the purpose of effecting land use control.

The major problem to be resolved is the rational allocation of land uses on a regional basis, and a compensating allocation of the financial resources available to local government.

2. Municipal and State Operations

The States generally accord to municipalities all the requisite powers to develop and operate airports -- even when such projected facilities are to be operated by private agencies. The power to acquire land for public purposes through condemnation; the power to levy and collect taxes to carry out governmental functions; the power to incur debt and to expend public monies; and the power to adopt and administer zoning ordinances and building codes are all public prerogatives essential to the development of airports and to the control of land uses within their vicinity.

Where a major airport can be developed within the boundaries of a single sponsoring municipality, and where the impact of fly-over noise is confined within those boundaries, the legal ability of the municipality to handle most of the problems which result from the clash of conflicting land uses is unquestioned. Even under this most advantageous situation, many practical problems attendant on the rationalization of land uses exist since the impact of the operation of a jet airport extends across enormous areas and creates major economic and political problems. However, most airport development occurs at the periphery or completely outside of the sponsoring city. In such circumstances the primary impact of the airport falls upon a number of communities. Here the use of extra-territorial powers by a central city to construct and operate airport facilities outside of its municipal boundaries is of no assistance in mitigating the noise problem of the other communities, as the sponsoring city does not have comparable powers to control land use activities around such airports.

In theory States are in an unusually advantageous position to plan, construct, and operate major airport facilities and to directly influence the manner in which land is used within the vicinity of such facilities. As the repository of police, condemnation, and tax powers which are extended to local units of government, the States can, and often do, exercise these powers directly. Highway construction, air pollution control measures, and water resource development are examples of functions in which States are directly active

and which require the use of a wide range of public powers. However, States are reticent to assume operating responsibility for activities whose direct benefits are apt to be localized, and which, in addition, are likely to be supported by central city interests and opposed by rural and suburban interests.

In general, States have moved to assist in those situations in which:

- (a) the State government is the only agency that can summon the resources required to perform the function.
- (b) the activity cannot be handled within the boundaries of the metropolitan area itself;
- (c) the activity requires as a matter of State policy that a minimum level of performance be achieved throughout the State that is not likely to be met by the jurisdiction or metropolitan areas independently, or
- (d) when the activity, if not performed, will result in problems which will seriously affect other parts of the State.

This description of the types of conditions which are most apt to trigger direct State participation closely parallels the situation in the Commonwealth of Puerro Rico, where the insular government has undertaken the planning, construction and operation of the island's major airports. As the Commonwealth government is also responsible for the planning, zoning, urban renewal and housing programs for areas outside of the principal cities, it is in a position to guide private development in the vicinity of major airports. Puerto Rico is atypical, however, in the extent to which development powers have been retained by the central government, although its experience is probably applicable to some of the smaller and to some of the less affluent States. Nevertheless, in most instances other administrative forms have to be examined to determine whether they can be appropriately used to construct and administer major airport operations. One such local governmental form which is receiving increased attention by public officials is the urban county.

3. County Operations

The county or its equivalent exists in every State except Rhode Island and Connecticut, and in the South and West it is usually a vigorous organ of administration. One of the most complex urban areas in the country, the New York metropolitan region, covers approximately 7,000 square miles and includes hundreds of local units of government but, exclusive of the five counties that comprise New York, contains only seventeen counties. An even more startling reminder of the size of some counties is San Bernardino County, California, which covers over 20,000 square miles.

In many instances the very large territory of a county gives it a special advantage in handling airport services for all or major portions of a metropolitan area. Where the boundaries of a county approximate the boundaries of a metropolitan area, which is the case in about two-third of the metropolitan areas in the country (primarily, however, the smaller ones), the assumption of various urban functions by the county can mean the provision of area-wide services without any changes in the geography of existing units.²

Historically, the county has been ineffective in the resolution of difficult urban problems, as it was developed in an agrarian era and was designed for the local performance of functions regarded as primarily of State concern. These functions consist mainly of the collection of revenues, the enforcement of criminal law, the peaceful adjustment of private disputes, the recording of land titles, the provision of inter-community highways, and the care of the poor. In exercising these functions the county acts as the agent of the State, and is tightly bound by constitutional provisions, with little discretion as to the selection of its duties. Nevertheless, in an increasing number of instances the urban county is able to shed such parochial restraints, and is emerging as a potent local administrative force. By 1962 thirteen States had constitutional home rule for their counties: Alaska (for boroughs), California, Florida (for Dade County only), Hawaii, Louisiana (for East Baton Rouge and Jefferson parishes only), Maryland, Minnesota, Missouri (for counties over 85,000), New York, Ohio, Oregon, Texas (for counties over 62,000), and Washington. Six states have laws authorizing optional county charters: Montana, New York, North Carolina, North Dakota, Oregon, and Virginia.³

In California counties are becoming increasingly important in the performance of urban functions as a result of their ability to contract with cities for various municipal services. Los Angeles County, for example, already closely approximates a metropolitan government. Despite the assumption of special area-wide responsibilities by counties, however, the cities of California exercise greater discretionary powers than do municipalities in most other States. There is a strong tradition of "home-rule" in California which is partially protected and promoted by the counties' assumption of functional responsibilities whose character is peculiar to the various urbanized areas of the state. The operation of a metropolitan-wide system of airports, for example, need not diminish the role of the individual municipalities. On the contrary, the shifting of operating functions and discretionary powers among various levels of local government can assist in the retention of discretionary control within the metropolitan region, and strengthen operating effectiveness. Thus it can assist in the economy of scale, provide a better relationship between taxes and benefits, and retain local control over area-wide concerns while preserving local responsibility for non area-wide services.

Where the accident of local boundaries makes a county a logical sponsor or participant in the development of an area's system of airports, the county's established multi-purpose structure can often be employed to advantage. Close to fifty per cent of the urban counties reporting to the Municipal Year Book in 1962 had zoning ordinances, a quarter of which applied to incorporated areas that did not have their own ordinances as well as to the unincorporated sections of the counties.⁴ Partly as a result of the Urban Planning Assistance Program of the Federal government, sixty per cent of the urban counties

reporting in 1962 had a county planning agency, many of which had superior planning staffs. In 1964 the Executive Director of the National Association of Counties could report to the Municipal Year Book that:

Urban counties made important strides in inducing and controlling development in 1963. Urban renewal began to look more like a county preoccupation as a significant percentage of the nation's 55,000 local government employees in urban renewal were provided by counties. DeKalb County, Georgia, has the results of a two-year industrial development program...80 new plants with \$8 million added to the county's valuation each month. Gaston and Cleveland Counties, North Carolina, showed similar growth wiping out the last vestiges of unemployment in the Charlotte area. Allegheny County, Pennsylvania, made use of a no-longer-needed county work farm and converted its 437 acres into an industrial park for the Pittsburgh region.

Forward looking counties took measures to insure balanced development and beneficial growth patterns. Jackson County, Missouri; Montgomery County, Pennsylvania; and Santa Clara County, California, strengthened open-space programs to provide future population with green areas. Careful county planning has made possible the development of whole new towns, complete with a variety of housing, commerce, industry, recreation, schools, and public facilities. Orange County, California, has a planned town that will cover an area six times as large as that of Manhattan. Reston in Fairfax County, Virginia, is under way after a pioneering effort in community development planning by county officials and developers. Howard County, Maryland, will have 120,000 new residents added to its population when a new 14,000-acre community between Baltimore and Washington is completed.⁵

Whether a county acts alone or in concert with other counties or with municipalities, the special financial and operating problems attendant on airport development, as well as the inter-community influence of major airport operations, have led public officials to explore new techniques of cooperation. One such device that is being widely employed is the "authority" or "special district".

4. Special Districts and Other Autonomous Public Agencies

Broadly speaking, special districts are:

...organized (governmental) entities, possessing a structural form, an official name, perpetual succession, and the rights to sue and be sued, to make contracts, and to obtain and dispose of property. They have officers who are popularly elected or are chosen by other public officials. They have a high degree of public accountability. Moreover, they have considerable fiscal and administrative independence from other governments. The financial and administrative criteria distinguish special districts and other governments from all dependent or subordinate districts and from most authorities which, lacking one or both of these standards, are not governmental units.⁶

There are, of course, various types of special districts. The coterminous district, one whose boundaries correspond with a specific municipality, includes most local housing authorities and school districts. Districts on the urban fringe and in rural areas generally pertain to unincorporated territory and often are created to supply necessary utility services to expanding residential development. However, it is the so-called metropolitan district, the specially devised government unit which extends throughout the major portion of a metropolitan complex, whose future is specially involved with the resolution of complex-transportation problems.

Like other special districts, the primary feature of the typical metropolitan district is its highly specialized nature. It is most often created to perform a single function. Well-known examples of such special district organizations are the Metropolitan Airports Commission in the Minneapolis area, the Huron-Clinton Metropolitan Authority in the Detroit area, and the Metropolitan Park District and the Metropolitan Transit Authority in the Boston area.

The important controlling force in the creation of metropolitan districts is the State, as such districts are normally locally established pursuant to enabling legislation applicable anywhere in a State. The usual impetus for such legislation is a request by local officials for special powers to handle a specific problem shared by several local jurisdictions. The common method for organizing metropolitan districts under established enabling legislation is the petitioning of some higher unit of government and the submission of the proposal to the electorates of the various units of government which are to be included within the boundaries of the special district.

Such districts have several important virtues. Generally they are established to cover the geographic area within which the most pronounced effects of a public problem are experienced. Thus the Metropolitan Transit Authority of Boston owns and operates

mass transit facilities throughout the densely populated areas of the Boston metropolitan area; and the Cleveland Metropolitan Park District which covers some 480 square miles, including the City of Cleveland, owns approximately 14,000 acres of land, some of which is outside of the district's formal boundaries. The latter District evidences a second attribute important to many metropolitan districts; it has the ability to incorporate additional areas in a more simple manner than the usual arduous annexation process accorded municipalities .

A strength which accrues to the usual metropolitan district as a result of its large jurisdiction is its ability to draw upon the financial resources of the entire area. This is a matter of great importance, as the principal obstacle to the resolution of most urban problems is the lack of an adequate and equitably based tax program.

The principal source of revenue of most metropolitan districts derives from charges for the services which are rendered. Special fees and assessments, consumption charges, tolls and rents are the common types of levies. In addition, most special districts can issue bonds which are usually retired from specially derived revenues. However, in many important instances, metropolitan districts are specially authorized to tax real property within their district. Usually there is a stated ceiling on the amount that can be levied, but the ability of a district to rely at least partially on this stable form of municipal income assists in assuring a constant level of service.

One of the generally recognized virtues of most metropolitan districts is their unusual excellence of public administration. Many of the large authorities, while sometimes criticized for myopia in their policy vision, are simultaneously commended for the highly professional manner in which they administer their programs. The ability to employ and to retain the services of an interested and informed leadership as well as a professionally oriented staff, is largely due to the technical nature of the district's activity and the common belief that its successful management depends upon the removal of the agency from politics.

Unfortunately, the organizational structure designed to take metropolitan districts out of the mainstream of partisan politics has its negative aspects. The principal service performed is often isolated from broader metropolitan considerations, and the legitimate forces at work to make the agency responsive to popular expressions of opinions are thwarted.

One of the overriding needs in the resolution of metropolitan-wide transportation problems is the effective allocation of resources to the various means of transportation. It is not unusual to find a major authority handling profitable toll operations relating to auto use while mass transit facilities within the same metropolitan area flounder in deficit operations. The inadequate integration of major airport operations with other necessary modes of transportation is equally well known. Thus, the creation of separate authorities to handle very specific aspects of an important public function can lead to wasteful expressions of self-interest and competition for public monies.

Although metropolitan districts offer specialized service, they do not enforce two important instruments in the control of development over large areas: building codes or land use regulations. However, these limitations can be substantially overcome if the special district is the creation of a large county or takes the form of a joint city-county or a multi-county authority. In such instances, the regular organs of local government are in a position to augment the specialized operating force of the special district. The same is true, of course, if the authority is a State agency such as the New York State Park Commission or the previously mentioned Puerto Rico Ports Authority.

The jurisdictional boundaries of the special district of the Port of Seattle are coterminous with King County, Washington, which includes the City of Seattle. In this instance the Port of Seattle is responsible for the development of and operation of port facilities for all modes of transportation, including the region's commercial air facility, the Seattle-Tacoma International Airport.

Dade County, Florida, is in a unique position as regards the effective coordination of airport operations with general land development policies since the directors of the Dade County Port Authority are the County Commissioners and the County operates under a home rule charter. In 1945 a special act of the Florida Legislature vested the County Board of Commissioners with the powers of a Port Authority and authorized the Authority to build, lease, operate and maintain airports, and other transportation projects including administrative buildings, toll highways, tunnels, causeways and bridges ancillary to airport operations. Later, in 1957, the County was provided with a council-manager form of government and sufficient home-rule provisions to make it probably the only truly metropolitan government in the United States. ⁸

Because of the pervasive and complex nature of transportation problems greater ingenuity will probably be employed in the future in the arrangements devised to resolve these problems than in any sphere of metropolitan concern. In an effort to devise methods for overcoming the usual limitations of metropolitan districts - their piecemeal approach to the solution of broad public problems, their addition of still more agencies to an already complex local governmental machinery, and their sometime lack of responsiveness to the will of the people - the Advisory Committee on Intergovernmental Relations has drafted model legislation pertaining to "metropolitan service corporations".

Accordingly:

The metropolitan service corporation proposed could be of a multi-functional type that would meet the argument that the authority inevitably leads to a piecemeal and fragmented approach. In the form proposed it would be susceptible, if the area residents so chose, of handling numerous areawide services and functions. Secondly, by providing for a board of directors made up of members ex officio from boards of county commissioners, city councils, and mayors, the affairs

of the corporation would be kept in the hands of elected officials and not entrusted to an independent, untouchable body. Poor performance of the corporation would carry the possibility of retribution at the polls for its board of directors. Third, the corporation could at the most result in the addition of a single unit of government in any given metropolitan area, while holding the potentiality of absorbing the functions and responsibilities of a considerable number of separate organizational units within the existing units of local government in the area.

In summary: (1) the draft bill would authorize the establishment of a "metropolitan service corporation" on the basis of a majority vote in the area to be served by the corporation, pursuant to an election resulting either from resolution of the governing bodies of major local governments or from petition.

(2) The corporation would be empowered by statute, subject to local voter approval, to carry on one or more of several metropolitan functions, such as sewage disposal, water supply, transportation, or planning. If the function of comprehensive planning were voted to the corporation, performance on a metropolitan area basis would be required, in contrast to permission for a smaller "service area" in the case of other functions.

(3) The corporation would be governed by a metropolitan council consisting of representatives from the boards of county commissioners, and from the mayors and councils of component cities.

(4) The corporation would have power to impose service charges and special-benefit assessments, and to issue bonds. Whether the corporation would also possess property-taxing power would depend on the range and nature of its authorized functional responsibilities.⁹

The suggested legislation is similar to that adopted in the State of Washington and obviously provides an improved instrument for the establishment of metropolitan service districts. However, while it both permits and encourages metropolitan planning activities of an advisory nature, it does not include authorization for effecting major land use changes through regulatory measures or by specific action programs, although there are no legal prohibitions against a State's inclusion of such provision in enabling statutes.

D. ZONING

Zoning, in theory, should be able to produce land use patterns compatible with aircraft noise. In actual practice, however, zoning often falls short of its desired local objectives for a variety of reasons. In most instances, zoning appears after the patterns of development are fixed, and simply reflects the existing situation. Zoning can be of significant use only in connection with a well thought out comprehensive land use plan, and then only as applied over the long run in hitherto undeveloped areas. Further, in dealing with the problems of aircraft noise, which usually affects many municipalities in the vicinity of an airport, zoning is at a disadvantage, since it is generally administered at the local level. To be effectively used in connection with the noise problem, zoning would have to be carefully coordinated at a higher level, or else transferred to another level of government that can take the entire affected area into consideration.

1. General Nature

Zoning is the employment of the police power of the State to regulate the use of land and buildings, their height and bulk, the proportion of the lot they may cover, and the density of population.

Zoning can be used by airport planners in cooperation with municipal authorities to prevent the entrance of noise-sensitive activities into the airport noise-affected area and to discourage the extension of existing noise-sensitive activities. Over a period of time, isolated undesirable uses can be eliminated.

This type of control is accomplished by dividing an area into districts, within each of which a specific set of regulations is applied uniformly to all property. In any general discussion the term "zoning" refers to this broad application of land use control. "Airport zoning" is a restricted special use of the device.

The basis for zoning derives from the power of State governments to restrict or regulate private action in the broader interest of the health, safety, morals, or general welfare of the community as a whole. Actually the zoning power is rarely exercised at the State level. A notable exception is Hawaii, one of the smallest States, as well as the newest.

Prior to achieving Statehood, the territorial government of Hawaii had undertaken a program to prepare a comprehensive general plan for the entire territory. Under the Land Use Law of 1961² a State Land Use Commission was created whose duty it was to divide the State among four kinds of generalized land use districts, based on the comprehensive plan, and to prescribe the regulations for land use in each district. The four districts

are: agricultural, conservation, rural, and urban. Within this framework, the four counties of Hawaii may adopt detailed zoning provisions.

In Massachusetts the State Constitution provides for the legislature itself to exercise zoning power in certain instances.

In Nebraska a statute was adopted during World War II which authorized the creation of a State Zoning Agency. Its power superseded all local planning and zoning autonomy in counties and/or municipalities affected by the location of Federal military posts and munitions plants, as the legislature felt that the intensity of development activity in these areas, coupled with the large influx of people, presented problems beyond the capacity of any individual municipality to handle.³

Such instances of states becoming directly involved in zoning are unusual. Zoning is normally exercised at the lowest levels of government where it is most responsive to local needs and pressures. In Louisiana and Missouri the power to zone is specifically conferred on local governments by the State Constitutions; the Constitutions of four other States (Delaware, Georgia, New Jersey, and Pennsylvania) provide that zoning powers may be conferred on local governments by the State Legislature. In the majority of instances, however, zoning powers are conferred on local government by the legislature through State enabling acts derived from the police power. These are frequently modelled after the standard State Zoning Enabling Act published by the United States Department of Commerce in 1926.⁴

In a few States the grant of zoning power is not a general one which applies to all municipalities; rather the legislation is restricted to cities or to classes of smaller municipalities. In more than half the States the zoning authority extends to county governments.⁵

2. Relationship of Zoning to Planning

Zoning has come to be the most widely used device for the control of land use. More than 85 per cent of the municipalities with more than 5,000 population in the United States have adopted zoning regulations.⁶ Because of its close association with planning, zoning is frequently confused with planning. This is due in part to the language of the enabling statutes that require a zoning ordinance to be in accordance with a comprehensive plan and in part to the fact that many communities adopted zoning ordinances before they became actively involved in organized planning programs. Zoning is not planning, however.

As described by a former President of the American Institute of Planning,

Planning, to be both realistic and effective (and it must be both to be either) must be regarded as a continuing process in public administration, consisting of (1) the

establishment of policies with respect to the desirable physical form and character of the community and (2) the use of these policies as a guide (a) for public activities and (b) for various regulations applying to private development.⁷

Zoning is but one of the regulations, albeit a major one, by which comprehensive development plans are implemented.⁸

3. Effectiveness of Zoning

Zoning has been in use for more than fifty years, sufficiently long to allow for an assessment of its strengths and its weaknesses. Where zoning has been based on a well thought out comprehensive plan and has been stoutly administered, excellent results have been achieved in terms of preserving the quality of a community. However, such instances are atypical and are more common in small communities rather than in large municipalities or cities.

Zoning has visually produced very mixed results, partly by reason of the exclusive reliance on zoning as the device for guiding development, often without proper planning as a base, and partly as a result of the watering down of the zoning regulations by variances and amendments granted without regard to the overall objectives of the ordinances.⁹

Some of the weaknesses of zoning are inherent; others are the result of poor administration. A primary weakness is that in most instances zoning cannot be retroactive; structures or uses existing at the time of the adoption of a zoning ordinance are generally not affected by the regulations even though the structures or uses do not comply with the regulations. Other weaknesses of zoning are: the essentially negative character of the instrument and its relative lack of flexibility in the face of swift changes in technology and living patterns; the general insistence that it be effected exclusively at the local level; and the lack of understanding on the part of many local administrators and municipal officials of the proper role of zoning.

Non-Conforming Uses: Structures or uses that antedate the zoning regulations and that do not meet the requirements of the district in which they are located are termed "non-conforming". As the laws in the United States reflect a high regard for property rights, it is difficult to remove such uses even though they are at odds with long range comprehensive plans. In a few States non-conforming uses are granted special protection by the enabling legislation and are exempted from municipal action to eliminate them under zoning. On the other hand, in a small number of States, the statutes provide that the discontinuance or elimination of such non-conforming uses legally may be required in the zoning ordinance provided that certain minimum safeguards are met, such as a reasonable period within which the owner may amortise his investment.¹⁰ In the majority of the States, however, non-conforming uses are permitted to continue but are not permitted to expand or to change

unless they conform to the zoning regulations. They may even be reconstructed after a fire or other catastrophe provided the damage does not exceed a stated proportion of their value.

It is apparent that in the main, municipalities cannot rely on zoning to eliminate non-conforming uses. The alternatives to their continued existence appear to be outright purchase by the public or by private individuals who feel strongly about their continued existence; condemnation by the health, housing, or safety administrators if the uses fail to meet the provisions of regulations governing those matters; or acquisition by condemnation if necessary under urban renewal procedures. As such non-conforming uses are generally incompatible with surrounding uses, they contribute to the instability of an area and provide a criterion for clearance or rehabilitation.

Negative Character of Zoning: Zoning developed from rudimentary controls over land use that were based on nuisance. Many ordinances still consist of long lists of prohibited uses and are weak for the very reason that with the passage of time the kinds of uses that may be compatible or incompatible in a particular area change. Further, such zoning is a restriction on, rather than an incentive to, private development. A zoning ordinance does not create new ratables nor build a community. It establishes minimum ground rules which guide individual actions.

In recent years there have been attempts to introduce new zoning approaches that are more positive in nature. One is to provide for "exclusive" districts within which only specific classes of use may be permitted. Another is to substitute performance standards for the long lists of prohibited uses. However, as these devices often require not only sophisticated equipment but also specially trained technicians and administrators, it is difficult for the average small community to attempt such refinements.

Lack of Flexibility: Granted the theoretical efficacy of new approaches to zoning, it is frequently difficult for a municipality to undertake them without specific enabling legislation from the State. In part this is because State enabling legislation must be general in stating the principles that apply to all municipalities but specific in defining the powers granted to local government. The precise powers required to effect certain zoning techniques may be inadvertently restricted by omission or by lack of clarity of the language of the legislation. However, to be effective, zoning must be tailored to meet the requirements and the circumstances of each individual community. ¹¹

A body of zoning law has been built up case by case from tests of local ordinances. Although each ordinance was applicable to a given set of circumstances, the legal decisions establish precedents which encourage or inhibit the actions of other jurisdictions. A community which undertakes zoning innovations must be prepared to face long and expensive court proceedings, even if it is assured of legal support for its actions and especially where there is no specific mention in the enabling laws of the precise kind of regulation that is being attempted.

This situation has been demonstrated recently with regard to the device known as "cluster zoning", which provides for a reduction in the average size of lots in a subdivision provided the developer dedicates the "surplus" land to public recreation or other open space use. In New York State, the City Law and the Village Law contain specific authorization for the local governing body to confer upon the planning board the power to modify the precise requirements of the zoning ordinance in considering a subdivision plot. For a long time, however, there was no similar provision in the Town Law which affects ninety-five per cent of the territory of the State. Under the circumstances no Town could consider cluster zoning until appropriate legislation was adopted by the State legislature.¹² In New Jersey, where the zoning enabling statute applies to all municipalities, there is no specific mention of such a power, but it has been implied. When the Township of South Brunswick adopted regulations pertaining to cluster zoning as an integral part of its zoning ordinance, it was required to argue the case for its action in the courts where, happily, its position was sustained.¹³

Extra-territorial jurisdiction: One of the serious impediments to the use of zoning to resolve problems on a metropolitan or regional basis is the difficulty in overcoming the strong sentiment for "home rule", which is based partly on the fact that, from its inception, zoning has been exercised almost exclusively at the lowest level of government. This impediment is often encountered in efforts to control land uses in areas affected by airport operations where aircraft noise extends across many municipal boundaries.

In more than thirty States, the counties have been granted zoning power over unincorporated lands. These powers have been exercised almost exclusively in areas where the pressures for new development have spilled over the municipal boundaries. In nine States municipalities have been given the power to zone the land beyond their corporate boundaries within a distance of up to three miles provided there is no county zoning in effect.¹⁴ The Advisory Commission on Intergovernmental Relations suggests that this practice should be more generally employed and has proposed a standard enabling act to be adopted by other States.¹⁵

The coordination of zoning on an area-wide basis can be accomplished in a variety of ways. The example of Hawaii has already been described. This, however, is really a special case based on the intense concentrations of population in a relatively few developed areas among the islands, the knowledge gained in a relatively few developed areas among the islands, the knowledge gained from previous planning as a territory, and the opportunity to start afresh as a State. In few cases has it been possible otherwise to overcome the intense emotions aroused by attacks on "home rule" powers. In most instances where action has been taken at a metropolitan or regional level it has been of an advisory or coordinating nature. An outstanding exception is Marion County, Indiana, which includes Indianapolis, the State capital, and twenty-three other municipalities. An act of the State legislature in 1955 withdrew all planning and zoning powers from the several municipalities and the county government and vested them in a Metropolitan Planning Commission, which was charged with the preparation of an area-wide plan of development and a comprehensive zoning ordinance. The County Council was assigned the responsibility for the legislative enactment of the ordinance.¹⁶

If zoning is to be at all effective in assisting in the control of land uses around major airports, it will, in most instances, have to be developed and administered on a multi-jurisdictional level such as the example of Marion County represents. Practically, such a procedure need not involve the making of detailed decisions at a level above that of the local jurisdiction. Rather it could mean the development and enforcement of basic policy decisions concerning major land use groupings and overall density standards. Within the confines of these general, area-wide determinations, local jurisdictions could be free to handle all zoning matters.

An intermediate position has been taken in New York where the counties have no zoning powers. The City, Town, Village, and General Municipal Laws were amended in 1964 to provide for a measure of coordination of municipal zoning actions. Except for those counties which operate under special charters (which are therefore free to make their own rules), where a county has a planning board all municipal zoning actions affecting land near municipal boundaries, county and State parks and reservations, parkways, expressways, and other limited access highways, or designated streams or drainage channels, must be reviewed by the county planning board prior to final action by the municipality. Where there is no county planning board, a minimum of intermunicipal coordination is required, and the affected neighboring jurisdictions are accorded the right to appear at the required public hearings to present their comments (though they are denied the privilege of resorting to judicial action).¹⁷

Administrative Problems: The fact that zoning operates almost exclusively at the local level subjects it to weakening from several directions. One is the lack of expertise of the officials responsible for preparing zoning ordinances, for enforcing them, and for supporting them when they are attacked in court. Most zoning ordinances were created without basic planning considerations in mind, and generally there is no professional staff on hand to assist the local legislative body to define and articulate the intent of various zoning provisions and the proper standards or safeguards that should be adhered to in establishing various kinds of regulations. In addition, although zoning is an important tool of local government, it represents only a minor element of municipal law; few municipal attorneys can give it the attention it should have.¹⁸ Further, the enforcement of zoning ordinances is customarily assigned to another official, usually the building inspector, whose professional training is often very narrow. Only in recent years has the full-time zoning administrator made an appearance, and then principally in the larger cities and towns.¹⁹

As zoning ordinances acquire new complexity, not only in their substance but in the gadgetry required for enforcement of performance standards, the zoning administrator required additional special training and a broader knowledge of the aims of the ordinance for which he is responsible. Such expertise may be costly; certainly it is in short supply. It is more likely to be afforded at a higher level of government where the economy of larger scale administration and operation makes it possible to employ professional specialists and to use their services to best advantage.

The second factor which reduces the effectiveness of most zoning ordinances is the unnecessarily large number of actions of the local legislative body in amending the zoning map or the regulations for particular districts, usually in response to pressure from property owners or prospective developers. Such decisions are often made with limited objectives in view - frequently only the temporary advantage of a new structure added to the assessment rolls. While the immediate results may be pictured to the governing body as increased tax revenue, jobs, or income from the sale of municipal property, there is seldom a long, hard look at the eventual outcome of any such re-zoning, such as could be provided by an adequately staffed planning agency with a good working knowledge of the community's needs and resources.

A third direction from which weakening actions are taken stems from the operations of boards of appeals. These public bodies, created to protect the individual property owner against any undue harm which might be caused by the strict interpretation of the regulations, frequently fail to grasp the relationship between their activity and the general community goals as expressed in the zoning ordinances. In many instances, instead of protecting the municipality by permitting only the minimum variance required to alleviate a hardship, boards of appeals go to the opposite extreme and approve any variance virtually without qualification. It has been difficult to restrict the actions of such quasi-judicial boards, because the usual legislative language by which they are created does not provide clear standards for the review of cases or for findings of fact on which to base decisions.²⁰

4. Zoning for Open Space

One result of the population "explosion" has been an increased interest in ways and means of preserving open space in an near urban areas.²¹ In addition to wooded areas and forest preserves, such open spaces include agricultural lands, flood plains, golf courses, and other lightly used tracts of land. The provision of such spaces in the general fabric of a community can reasonably fall under the general welfare provisions of the police power as a means of restricting the overall density of population. However, there is an understandable reluctance to preserve open land through zoning. Indeed, where attempts have been made by municipalities, they have usually been struck down by the courts as an unlawful taking of property rights without due compensation.²² Nevertheless, in States where there is considerable conflict between the pressure for urban development and the desire to retain lands currently in agricultural use, the principle of exclusive agricultural zoning has gained acceptance.²³ This device is being used extensively in California especially in the Santa Clara Valley. Such agricultural zoning is the principal device being employed to protect the proposed new Sacramento Metropolitan Airport against incompatible land uses in its vicinity.²⁴ Agricultural zoning has been employed in similar fashion in Lancaster County, Pennsylvania, where the County Airport is also located in a farming area.²⁵ Unless such an interest in agriculture is present, however, it does not seem reasonable to expect that large tracts of open land around airports can be retained in an open state through zoning. Positive action is required in such instances, such as public acquisition of land or of rights in land in connection with programs for conservation of recreation.²⁶

5. Airport Zoning

The approaches to airport runways require a minimum of unobstructed space that must be protected against encroachment by high structures. The Federal Aviation Agency requires that public airports constructed or improved with Federal funds have this kind of protection. Since height of structures is among the features subject to zoning control, it has been customary to refer to this protection as "airport zoning". Also, it is becoming accepted practice to include the provisions for airport protection in the comprehensive zoning ordinance, especially where all the territory involved is under a single jurisdiction.²⁷

Airport zoning, however, is based on certain other elements of the police power and properly requires separate enabling legislation. The model statutes prepared by the Federal Aviation Agency and by the National Institute of Municipal Law Officers, for use at the State and local levels, have been utilized in somewhat haphazard fashion.²⁸ The basic statutes have seldom been tested in court and certainly never on a matter of substance. Thus far, efforts to clearly establish the extent of Federal interest in and responsibility for such zoning have been unsuccessful. Although the national interest in aviation has been demonstrated, the continuing policy is that the development and operation of airports is a local matter.

The basic test of airport zoning thus far appears to be its reasonable application. Where an airport does not acquire sufficient clear zone and where the municipal airport zoning ordinance does not provide minimum safeguards for the relief of property owners close to the ends of the runways, where the inclined plane defining the protected airspace extends so close to the ground as to preclude the reasonable use of the land, the ordinance may be ruled unconstitutional, as a taking of property rights without due compensation.

A major problem related to the protection of airports and the proper use of land in their vicinity is that frequently the territory affected by airport operations is in two or more jurisdictions, only one of which is under contract to the Federal agency and therefore under compulsion to take the steps necessary to protect the airport approaches. The President's Airport Commission in 1952 recommended a combination of airport zoning and comprehensive land use zoning to restrict not only the height of structures in the vicinity of the airports but also the character of development and the density of population in areas exposed to hazards from aircraft crashes.²⁹ Such a provision was written into the Federal Airport Act only in March of 1964.³⁰ However, so far as can be determined there has been little effort exerted thus far to achieve coordination of airport development and protection with land use controls, especially where there is more than one jurisdiction involved.

An exception to this situation is the City of Chicago, which is working on an agreement with the several municipalities affected by the operation of O'Hare International Airport. In this case, however, the power to effect airport zoning no longer rests with any of the municipalities, the State of Illinois having withdrawn that power from

local governments and vested it with the State Commissioner of Aeronautics. ³¹

Sacramento, California; Tulsa, Oklahoma; and Wichita, Kansas, are other cities ³² where comprehensive planning is attempting to relate airport development with land uses. A demonstration project study for the HHFA has recently been completed based on the Detroit Metropolitan - Wayne County Airport, where a single community, the Township of Romulus, surrounds the airport and is subjected to the bulk of objectionable aircraft noise. The Township has taken the initial step of re-zoning land exposed to fly-over noise to a Transitional Zone, while awaiting completion of State and Federal review of the Comprehensive Land Use Plan upon which the balance of the municipal program is to be predicated.

Most states which expressly permit municipalities to acquire, develop, and operate airport facilities outside of their corporate limits, also authorize municipalities to develop and enforce zoning regulations designed to protect flight operations. ³³ In most instances, however, the intention of such legislative authorization is to prevent the erection of towers, poles, wires or other hazardous obstructions, and does not extend to the adoption of district zone classifications which control the use to which land can be put in the vicinity of airports. Thus, the statute of the State of Montana which authorizes extraterritorial zoning powers in connection with airport development and which is representative of such legislation provides that:

If in the judgment of a political subdivision owning or controlling an airport, the political subdivision within which is located an airport hazard area appertaining to that airport, has failed to adopt or enforce reasonably adequate airport zoning regulations for each area... and if that political subdivision has refused to join in creating a joint aircraft zoning board...the political subdivision owning or controlling the airport may itself adopt, administer, and enforce airport zoning regulations for the airport hazard area in question. ³⁴

It is clear that airport zoning, in and of itself, has a minimum short term impact on land use patterns. There can be no assurance of compatibility between the airport and its neighbors until such time as a general development guide can be prepared for the entire area affected by airport operations and adequate zoning devices can be effectively coordinated with other public instruments which affect development.

E. BUILDING AND HOUSING CODES

Building and housing codes, which affect the construction, the layout and size of interior spaces, and the provision of certain amenities, appear to be a logical vehicle for enforcing acoustic standards. Such standards affecting the transmission of sound within structures are now being devised and considered in connection with the current program of transforming building codes to reflect performance standards rather than the specification of materials and dimensions.

1. Building Codes

Background

Efforts to prohibit building practices inimical to the health and safety of the public reach back a long way, perhaps to 2,000 B.C. and the Code of Hammurabi wherein, if a man built a house for another man, and built so badly that the house collapsed and killed the owner, the builder was put to death.

In less dramatic form, in colonial America local ordinances controlled the construction of chimneys and roofs, and, subsequently, other important components of residential structures. The gradual accretion of such regulations and their codification into building codes have come to constitute the primary local device for insuring minimum requirements for light, ventilation, safety, sanitation and fire protection. Such regulatory measures have gradually expanded to cover most building construction practices and have been grouped, in most instances, into extremely complex sets of regulations.

Building codes can be extended to include sound proofing provisions for buildings in noise affected areas or areas which are expected to become so affected on the basis of projected airport activity. Since building codes apply to new construction, they will not help alleviate existing noise problems.

The increasingly complex and diverse local building codes - there are currently more than 5,000 different codes in force in the United States - have a concentrated attention in the last several decades upon the development of common standards or model codes which can be adopted, often by reference, by local communities. Several of these, such as the Uniform Building Code, developed by the International Conference of Building Officials, and the Basic Code, sponsored by the Building Officials Conference of America, have assisted in reducing many of the glaring discrepancies among locally drafted standards. However, much remains to be done in the standardization of building controls; for nearly every metropolitan area has literally scores of different codes with widely varying construction standards.

Several metropolitan areas, often taking their lead from county-wide groups, have made significant advances in the standardization and simplification of building requirements. A single model code has been adopted by the local jurisdictions within St. Louis County; and in Allegheny County, around Pittsburgh, some thirty of the one hundred twenty-nine communities have adopted the Uniform Building Code.¹ Similar efforts exist around the country.

Performance Standards

Allied with the efforts to achieve a greater harmony among the codes of various local jurisdictions are the efforts to shift the emphasis of control from the detailed specifications of materials and equipment to the elaboration of minimum performance standards. The

State of New York has progressed unusually far in creatively involving itself in obtaining the local adoption of and subsequent compliance with improved building construction performance standards. It has done this primarily through the development of the New York State Building Construction Code,²

...a performance code which uses nationally recognized standards established by industry groups or independent testing organizations. Established in 1950, it now serves 421 communities with a total population of more than 5 million (65% of communities in the state that are "codeable" - that is big enough to benefit by a code. (sic.) It is generally recognized as the clearest and most comprehensive on the books anywhere. It consists of four sections: residential one-and two-family, multiple dwelling, general construction, and plumbing. These are contained in four pocket-sized booklets, none over 200 pages long. They are accompanied by an advisory manual which illustrates and explains commonly used materials and methods which meet the code's performance standards in such clear terms that any layman can understand them.

Under the state law setting it up, adoption of the code is voluntary. Administration and enforcement are local responsibilities. Towns establish their own permit fees, hire inspectors, and even share their services with other towns using the code.

The code is kept up to date by a building code bureau in the state Division of Housing & Community Renewal. The bureau provides these services - all free - to communities using the code:

* Bulletins advising them of the latest generally accepted standards applying to the code, which are also compiled at least every six months in a booklet.

* Bulletins reporting what products have been reviewed and certified as acceptable by the code council.

* Aid in code interpretation, and in reviewing building plans that are too complicated or bulky for local officials to handle (e.g., a big industrial plant proposed for a residential village).

* Seminars and clinics for local officials, architects, builders, and others on the code, how it works and how to use it.

Under the code, the local inspector is the judge of whether a given material or technique satisfies the code. The manual and accepted standards are purely advisory. And the inspector is entitled to ask for proof. If it does not satisfy him - or the situation presents

practical problems in compliance which he cannot resolve - the owner, builder, architect, or producer may appeal to the construction board of review of the State Building Code Council for a review or variance. The review board's decision is binding unless either party takes the case to court. An application fee of \$10 is charged for this service. ³

Other States, however, have not proceeded as far as New York. About twenty have approved codes, but, for the most part, these have few specific standards, are purely advisory, and are limited to the regulation of buildings other than private residences and farm structures. ⁴

Noise Transmission Standards

Historically, construction codes have concerned themselves with establishing minimum requirements for structural safety and for light, ventilation, sanitation, and fire protection. Increasingly, as apartment development assumes a greater proportion of the home building market, standards are being developed and enforced which seek to reduce the transmission of noise within buildings, and the Federal Housing Administration has actively lent itself to the efforts to prevent disagreeable and recurring noises originating in one apartment or area of a building from disturbing families in other parts of the building - above, below, or adjoining on the same floor. A new code is being developed for New York City by Brooklyn Polytechnic Institute. The draft submitted to the City Government for consideration includes controls for the transmission of interior noise.

As yet, however, performance standards have not been developed and popularly adopted which consciously seek to prevent unusually high levels of noise generated outside of structures from penetrating into the interior structures. Traffic and general street sounds are the usual disturbances from outside, and the appropriate siting of structures and the use of standard building materials are normally adequate to attenuate this type of noise.

As manufacturing operations have historically been the generators of disturbances inimical to residential development, communities have sought through zoning to segregate industrial development from residential areas. Where previously established conditions have produced sharp conflicts between industrial operations and family living, publicly supported urban renewal activities have been employed to achieve this separation. However, the continued expansion of airport operations and particularly the introduction of jet aircraft create a condition wherein noise is distributed over very wide areas, great portions of which are otherwise admirably suited to residential development. In such instances it would appear reasonable that acoustical performance standards may be adopted which would have as their objective the attenuation of outside noise to an acceptable interior noise level.

The additional acoustical treatment required would unquestionable raise the total cost of construction above that required under "normal" conditions. However, if the area

under consideration for development was sensibly zoned, the additional cost would be consistent with the proposed land use. For example, in an area where it would be necessary to increase the cost of construction by 50% in order to reduce the interior noise level from 120 to 90 db it is obvious that a non-residential use such as a commercial or industrial enterprise of some kind would be more appropriate than private residences. Similarly, in a situation where required noise attenuation measures would increase the cost of construction by only 10% a residential zoning classification might be entirely reasonable.

Such varying situations are roughly analogous to the influence which topography has on zoning district classifications. Grades under 10% are normally considered as having little bearing on construction costs and thus are largely ignored in the determination of the kinds of development which are permitted within an area. Grades greater than 10%, however, may progressively raise the cost of site preparation as well as the cost of a structure. Increasingly, however, areas of unusual slope are neither prohibited from development, nor automatically classified as recreation. Their development potential is analyzed in the light of other relevant considerations, such as existing contiguous uses, the availability of access, etc.. Thus sites which from the standpoint of the steepness of the slopes are marginally suitable for development, often are deemed to be eminently suitable when viewed from a broadened frame of reference. Many areas around major airports can likewise be satisfactorily developed if the building and zoning controls are appropriately matched to the special requirements of the areas.

2. Housing Codes

Background

The development of housing codes is a much more recent development than that of building codes; they do not as yet have as wide a local application. In 1953, the Housing and Home Finance Agency stated in an official publication that, "... minimum housing standards are at present in a trial and error stage of development."⁵ This is still very much the case.

A housing code,

...establishes standards governing the occupancy, minimum facilities, and maintenance of existing structures used for habitable purposes. By occupancy is meant habitable space requirements, such as: minimum dwelling units space (per person); minimum ceiling height; minimum living unit space; regulation of use of basements and cellars; natural light requirement; and ventilation requirement.⁶

Since housing codes deal with existing conditions, housing codes could be used to enforce soundproofing of existing structures in noise affected areas around airports. The major problem then is to allocate the cost on a rational basis among the property owner, the

airport and the community. The fact that such codes are directed at existing conditions rather than prospective development accounts for the very different patterns of acceptance as between building codes and housing codes; it is obviously more difficult both politically and legally to impose higher standards retroactively.

California has a State housing code, which municipalities must adopt if they do not have their own. New York and New Jersey have prepared model housing codes which localities may adopt by reference. Some of the States, such as New York and Tennessee, provide technical assistance to local units for preparation of a housing code. These States are the exception, however, and by and large the States have done little to move their local governments toward housing code adoption or to help them. 7

The first model housing law was published in 1914. Until that time there were only tenement housing laws, based principally on New York City's experience. The States which adopted these model laws generally limited their application to cities over a certain size. In many instances they contained elements of both building and housing codes; this is still the pattern in some jurisdictions. Wide spread interest in the establishment of minimum acceptable living standards greatly increased during the 1930's, with the creation of the Federal Housing Administration, the Home Owners Loan Corporation, the advent of the public housing program and other measures designed to establish a popularly supported underpinning for the improvement of housing conditions. The national policy subsequently enunciated in the Federal Housing Act of 1949, was that every family was entitled to a "decent, safe, and sanitary home." Efforts to develop standards upon which housing codes can legitimately be based and to have such standards popularly accepted derive their force from this national concern. Currently, one of the most widely used codes is, A Proposed Housing Ordinance devised by the American Public Health Association.

Since the period of the 1930's there have been persistent efforts to have every community establish a housing code. These efforts have received their greatest support from the Federal government which, as an outgrowth of the Housing Act of 1949, required that before any community can participate in the urban renewal or community facilities programs it must have as part of its overall improvement plan (officially known as the Workable Program) a formally adopted and appropriately administered housing code. A basic reason for this requirement is the recognition that the local enforcement of the occupancy standards and other provisions of a housing code can materially retard the rate of decay within our cities. As the Federal government is channeling enormous sums into the revitalization of the country's urban areas, it considers it appropriate to request that local communities which are the recipients of Federal assistance develop procedures to insure that the rate of obsolescence and decay do not outstrip efforts to eradicate such conditions.

Housing codes, as is the case with building codes, have been seen primarily as the adoption of a single but comprehensive set of regulations which applies in a uniform manner throughout a particular community. Similarly, there does not seem to be any overriding

legal or technical obstacle to the inclusion of housing code measures which have application to special areas of a community, such as would be the case if "higher" standards were applied to districts especially affected by fly-over noise. An important component of contemporary zoning is the imposition of different requirements in different section of a community.

Problems of Retroactivity

The problem posed by the possible incorporation of such special provisions for different areas of a community is that as portions of a housing code they would apply to existing structures rather than, as is the instance of a building code, to new structures erected after the adoption of the code. The practical result of this situation is that, in order to establish the equitability of imposing extraordinary regulatory provisions, it would probably be necessary for the local community to establish special financial inducements to guarantee compliance. The various devices such as special loan and grant programs, tax abatement procedures, and the like, which can become part of an overall housing improvement program are discussed in detail in other sections of this report.

F. EMINENT DOMAIN

The theory of eminent domain, under which government may acquire property for public purposes, has been expanded in recent years to permit activities that were not previously considered to be public functions, such as urban renewal. In connection with the aircraft noise problem, eminent domain is applicable to the acquisition of limited rights in land, for aviation easements, restriction of development, preservation of open space uses, and other similar purposes.

1. General Nature

Historically "eminent domain" refers to the power of government to acquire private property for public use. In the United States this power is closely circumscribed by the requirements of fair compensation and "due process of law" as provided in the Fifth and Fourteenth Amendments to the Constitution. The major distinction between the power of eminent domain and the so-called police power is that, as a rule, the latter is used to regulate or restrict private property in general, while eminent domain affects a specific property which is taken from private ownership and appropriated to some particular public use.¹

Airport planning authorities can use eminent domain to acquire needed real property at a fair market price if the owner does not wish to sell or asks an excessive price. Planning authorities for a new airport can use eminent domain to complete assembly of necessary land in undeveloped areas and then use zoning and other techniques to prevent the incursion of noise sensitive activities.

If owners of property in noise affected area seek to limit airport operations to reduce their noise exposure, the airport authorities can use eminent domain to purchase these properties. The airport can then resell the property with a noise easement, thus obtaining relief from claims at minimum cost.

2. Des Moines Municipal Airport

The City of Des Moines, Iowa, obtained such easements for the Des Moines Municipal Airport, in the required clear zone beginning 200 feet beyond the end of the runway and extending out 2500 feet. Where necessary to remove obstacles or to provide sites for necessary LCS facilities, properties were acquired and buildings demolished. In most instances, however, easements were acquired over existing residences, many of which were one story high. At the outset, the city thought to obtain such easements for a token value of \$1. However, as property owners became aware of the program, the asking prices were raised. The average cost of such easements acquired by direct negotiation with property owners was \$250-300.

In a number of instances, the owners preferred to sell the property to the city, rather than suffer an anticipated loss in value of their houses. In other cases, where the city was unable to negotiate a reasonable price for the easement, the city invoked eminent domain and the full fee was condemned (at a price close to full market value). In both these types of instances, an easement was imposed through a deed restriction, and the house was offered for sale on the open market, through the prevailing multiple listing system. The sale price was generally lower than the purchase price by \$1,500 to 2,000. This amount was accepted by the city as the cost of the aviation easement. Three facts of interest came out of this program:

1. People are willing to live under the noise conditions close to the end of the runway which is exposed to over 110 PNdb. In part this is due to their becoming accustomed to the noise environment and in part to a reluctance to leave a neighborhood with which they were otherwise satisfied. The desirability of the area was born out by the willingness of other people to purchase houses in the area, accepting the noise as a corollary of the slightly lower money cost of the house.
2. In the recent re-appraisal of all property in the City of Des Moines by an independent consultant, no differential was included for the area subject to airport noise. All property in the city was found by the consultant to have appreciated in value, including both the residential and commercial areas in the vicinity of the airport.
3. Commercial properties very close to the edge of the clear zone have been re-developed and improved with one story service stations that comply with the height restrictions.

Under the police power, government may condemn and if necessary demolish structures in the presence of conditions judged to be injurious to the health, safety, or general welfare of the community. Abandoned and/or dilapidated buildings are the usual targets of such action. However, in these situations the government acquires no right, title, or interest in the property affected. On the other hand, under eminent domain, full or partial title is acquired by government. Where an owner is willing to sell for an agreed upon compensation, this transfer of rights may be achieved by negotiation in the same voluntary manner as most sales of real property between private parties. Where an owner is not willing to sell, or where agreement cannot be reached as to the fair value of the property, government can acquire title from the owner through condemnation with the amount of compensation determined through a judicial proceeding.

3. Acquisition for Public Purposes

The acquisition of private property by government in order to further a public purpose, as contrasted to a public use (such as a school, fire station, highway, park, or airport), is a recent and extremely significant innovation. The extent to which government can acquire and dispose of rights in real property has been greatly expanded as a result of the legal determinations by which this innovation has been sustained in the courts. In a large measure, the impetus for this broadened view of eminent domain stems from the efforts of the Federal government to assist municipalities to improve the living conditions of their residents.

4. Federal Legislation

The United States Housing Act of 1937² had as its objective the elimination of slum areas and the construction of public housing projects for low-income families. Under this Act municipalities were required to establish local public housing agencies. These in turn were empowered to use eminent domain to obtain title to property required for a project, to clear the land of its blighted structures, and to construct and operate housing projects on these sites. Since Congress had indicated the public purposes to be served (the provision of housing for families of low income who were unable to obtain decent, safe, and sanitary housing on the open market), eminent domain was used in its original sense. The innovation was the declaration of housing as a public "use".

The Housing Act of 1949³ authorized the Federal Government to extend financial assistance to States and local units of government for the clearance and re-development of slums and blighted areas. Under the provisions of this Act, a local public agency (defined in the Act as "...any State, county, municipality, or other governmental entity which is authorized to undertake the project for which assistance is sought.")⁴ was expected to acquire land in the blighted areas of a community, to clear the land within such areas, to re-plot the land into marketable parcels, to install the public utilities and services necessary to support the proposed re-use of the land, and then to sell or lease the land to private sponsors for redevelopment in accordance with an

approved plan. The primary objective of this legislation was still the alleviation of sub-standard housing and environmental conditions in residential areas. The land to be cleared had to be predominantly residential either before the project was undertaken or upon the redevelopment of the areas.⁵

The redevelopment provisions of the Housing Act of 1949 were based on the use of eminent domain. It was clearly intended that the title to property in blighted areas was to be acquired by local public agencies (not necessarily public housing agencies as specified in the 1937 Act)⁶ and by condemnation where necessary. However, once the land was assembled and cleared, the full title or limited right to develop such land was to be conveyed at a fair value to other private parties who would agree to build upon the land. The principle upon which this program rested was the belief that privately constructed redevelopment projects serve a public purpose.⁷ A series of profoundly significant court decisions sustained the premise that government may acquire rights in real property from one party and dispose of these rights to another party. One of the most important cases decided by the U.S. Supreme Court was Berman vs Parker in which Justice Douglas in his majority opinion declared, "Once the object is within the authority of Congress, the right to realize it through eminent domain is clear. For the power of eminent domain is merely the means to the end. . . . Once the object is within the authority of Congress, the means by which it will be obtained is also for Congress to determine. Here one of the means chosen is the use of private enterprise for the redevelopment of the area."⁸

The Housing Act of 1954 resulted in a further broadening of the use of eminent domain. In this Act stress was placed on techniques for preventing the development of blight and for ameliorating adverse environmental conditions through rehabilitation rather than the total clearance of existing structures.⁹ In contrast to clearance projects entailing immense acquisition costs, the 1954 legislation aimed for projects in which little of the land and few of the improvements within the project areas would be acquired by local public agencies.¹⁰ It provided for the adoption of local rehabilitation standards for residential properties and sought to encourage private owners to upgrade their properties to these standards. The future exercise of eminent domain was to be limited principally to the elimination of structures too dilapidated to justify investment in renovation; to the removal of obviously incompatible land uses (such as automobile repair shops in predominantly residential areas); to the clearance of impediments to the carrying out of a general plan for the area (such as structures astride the route of a proposed street change); and to the acquisition of structures whose owners either would not or could not upgrade their properties to acceptable standards. In the last-cited instance, local public agencies might acquire such properties, rehabilitate them, and sell them to new owners, or, after acquisition, sell the unimproved properties to other private parties who agree to carry out renovations to the desired standards.

Whereas the 1954 Housing Act still related to residential development, the Housing Act of 1964¹¹ extended the scope of urban renewal still further by providing for the rehabilitation of non-residential structures. It also authorized Federal assistance to programs that consist entirely or substantially of measures for enforcing housing and/or building codes. The possibility of using eminent domain powers as a back-up to rehabilitation

efforts and selective clearance projects assumes considerable importance in view of the variety of problems that must be resolved in dealing with properties affected by excessive aircraft noise.

Senator Joseph Clark of Pennsylvania introduced legislation during the 1963 session of Congress (S.2031) which specifically provided for urban renewal assistance to areas adversely affected by airport operations. This measure was opposed by the Housing and Home Finance Agency, which is responsible for administering the renewal program, primarily on the ground that few areas have the administrative instruments necessary to implement the program, but also because the Agency did not believe that noise alone could be accepted as a major basis for a declaration of blight in an area. Although the bill received little support, and eventually died in committee, it served to demonstrate the growing awareness on the part of Congress of the problems attendant upon airport development in urban areas. Even with massive Federal assistance, the cost of acquiring, clearing, and redeveloping the tremendous urban areas that are affected by the take-off and landing of jet aircraft is beyond the capacity of most municipal governments. A combination of selective clearance of structures and of rehabilitation of buildings to suitable acoustical standards seems to be more practicable.

It is too early to fully assess the significance of special code enforcement programs. However, it seems feasible to develop, at the local level, special code provisions applicable exclusively to areas affected by aircraft noise; to designate these areas as suitable for special code enforcement programs; and to obtain compliance with the code enforcement program because of a partial reliance on eminent domain for selective clearance.

5. Acquisition of Limited Rights in Property

Of developing interest is the use of eminent domain to acquire less than the full fee in real property. The use of this device is based on the premise that various public objectives often may be attained by acquiring only a limited interest in land. Thus, in the effort to restrain urban sprawl and to preserve large open spaces within metropolitan areas, it has been suggested by some thoughtful public officials that recourse be made to the acquisition of "development rights" or "easements." The latter term is preferred by many in the United States as the former is associated with the 1947 British legislation under which the national government sought to acquire the development rights of all land lying outside built up areas. However, regardless of the terminology used, the concept involves the public acquisition of a landowner's right to develop his property with any uses more intensive than those existing at the time of the transaction. He is, of course, compensated for this limitation of his freedom of action.¹²

Acquiring less than a fee, the whole bundle of property rights in land has been common for centuries, and there can be no objection to it in principle. Only a limited property interest customarily has been taken for railroads,

for highways, for the laying of lines and ducts for utilities, for flowage rights where water is to be impounded by a dam, and similar purposes. ¹³

In 1928, through the Rights in Land Act ¹⁴, the National Capital Park and Planning Commission was specifically authorized to acquire easements for park purposes. And more recently, in 1956, the Massachusetts legislature authorized the State Commissioner of Natural Resources to establish The Massachusetts Bay Circuit, "as a system of publicly and privately owned open spaces, including parks, forests, reservoirs, wild life preserves, scenic and historic sites, and other properties or reservations, surrounding Metropolitan Boston..." ¹⁵ and empowered him to acquire by eminent domain such property or interest in property as might be required. The statute also authorized him to acquire by negotiation and agreement such rights as he might deem to be necessary for the purpose of creating the Bay Circuit, ¹⁶ by a variety of means including contracts, leases, and gifts from private individuals.

The acquisition of limited rights in land rather than the full fee can be of significance in two major areas of public action. The first is where little or no development has occurred, and where the public acquisition of development rights may cost much less than the full fee. This situation exists, for example, where land adjacent to an existing or proposed major airport is used for agriculture, a golf course, or other open land recreation purposes, and it is in the long range public interest to continue these activities. In such instances the local jurisdiction would acquire only those rights that would preclude the owner from putting the land to a more intensive use. How much the owner would give up or be compensated for would depend on the circumstances in each particular area, including the pressure for development.

The acquisition of limited property rights appears to be particularly useful in those instances where development pressures around an airport have not reached a point where the cost of acquiring limited rights is tantamount to the full fee. This is most apt to be the case with new or proposed airport facilities.

Another instance where it may be advisable for a local government to seek to acquire a limited interest in property is where the imposition of height limitations under airport zoning is so restrictive as to constitute a taking of property. Here it is desirable that the responsible municipal jurisdiction acquire certain rights or easements over the property for which the owner can be compensated. This situation is covered specifically in the Flight Hazards Act of New York State. ¹⁷ The program under which the City of Des Moines, Iowa, has been acquiring "avigation easements" to protect its municipal airport has been described above. It must be clearly borne in mind, however, that as in all public takings of property, the acquisition of easements or development rights must be supported by evidence of a public purpose. Where this can be done, the use of public powers and funds is apparent, and the action can be supported in the courts.

6. Extra-Territorial Jurisdiction

Municipalities are able to purchase, or to acquire through eminent domain, property which lies outside of their formal jurisdiction when it can be demonstrated that such acquisition is designed to support a public use important to the well-being of the residents of the city. Reservoirs and sewage disposal plants are classic examples of facilities which often require that municipalities acquire and improve land outside of their corporate limits. Although most States expressly grant cities the authority to construct and operate extra-territorial airports, it is generally regarded as unnecessary for specific state enabling legislation to exist in order to support such an undertaking, for the courts usually take the view that cities may acquire and manage airports and other important facilities as a legitimate and logical assumption of their responsibility to provide necessary corporate service to their residents.¹⁹

Many states also permit the local government which owns an airport to impose special extra-territorial restrictions on the height of structures adjacent to the airport. Typical are cities and towns in Louisiana which may "police" their extra-territorial airports and enforce special zoning regulations which protect the approaches to the airports.²⁰ In most instances there are definite geographical limits within which such regulatory measures may be enforced. Thus, for example, cities of the first-class in Indiana are restricted in their zoning activities to the areas within fifteen hundred (1,500) feet of the airfield. There is as yet, however, no body of precedent to support extra-territorial condemnation and clearance or rehabilitation of structures, or other types of activities associated with urban renewal. As these are activities closely identified with the fundamental prerogatives of local government, it is likely that condemnation, renovation, and development powers must be applied within the formal boundaries of the affected jurisdiction.

G. TAXING POWERS

All but a few states impose severe constitutional and/or legislative restrictions on the use of taxing powers by local units of governments. In the few instances in which programs for tax abatement have been authorized, they have been limited to specific kinds of development, such as housing. Thus, although theoretically possessing considerable potential to assist in inducing compatible development, this device is not now generally available for local use. Counties and special districts, which have a broader tax base, appear to be in a better position to take action with respect to land use modification programs on a large scale.

1. General

A basic prerogative extended to local units of government by the separate States is the power to levy taxes. This authority derives from State constitutions and

statutes and is circumscribed by them as well as by Federal constitutional provisions. In most instances local powers of taxation are extended in an explicit manner. The severest restrictions are those which prescribe local debt limitations and which establish a ceiling on local tax rates. Most States have such requirements.¹

Taxing powers can be used to attract non-noise-sensitive activities to the vicinity of airports by giving preferential tax treatment to such activities. Taxing powers also can be used to encourage soundproofing of existing structures and soundproof construction of new structures by exempting the cost of soundproofing from the assessment of the property for tax purposes.

At various times the States have authorized local public jurisdictions to establish a wide range of imposts such as sales, income, and excise taxes. In general, however, local jurisdictions are too limited in extent to impose such taxes effectively and are so understaffed that they can not provide the trained personnel necessary to administer a sophisticated tax collection system. Moreover, the States, and more particularly the Federal government, have effectively pre-empted most types of imposts (the graduated income tax is the most dramatic instance of this pre-emption) with the result that most municipalities find themselves limited to a quite elementary tax base.

As a result of the numerous limitations imposed on local tax policies, municipalities must rely almost exclusively on the property tax and on special service charges as their primary sources of income. Although the property tax has certain faults it comprises the principal financial tool available to encourage various types of desired development.

2. Property Tax

In its broadest sense the general property tax is a tax on all tangible and intangible property, guided by designs of uniformity and equality, assessed at cash value or a constant percentage thereof, and taxing all property in a single taxing area of a common rate.²

Although the actual imposition of the property tax rarely conforms to this theoretical formulation, and there are legitimate criticisms as to the equity of the tax, reflecting either ability to pay or services received, it remains the basic locally collected tax. The judicious manipulation of the property tax can be of considerable value to a municipality in its search for techniques to encourage the development of land use patterns compatible with major airport facilities.

3. Tax Abatement

A technique increasingly employed to encourage development compatible with the general welfare of the country's local communities is selective, partial tax abatements; that is, the temporary relief from full real estate taxation. In the State of New York, under the Limited-Profit Corporation Law³ (often referred to as the Mitchell-Lama Act),

communities are empowered to grant up to fifty per cent abatement of local property taxes on new residential development for a period of as long as thirty years, if the developer agrees to produce housing at moderate rental rates. A special feature of the New York program is that the State as well as cities may make loans to developers covering up to ninety per cent of the cost, repayable over fifty years with the rate of interest the same as that paid by the State or city when it sells its bonds to raise the funds. Because of its great flexibility this is an extremely popular and successful program. The Mitchell-Lama Act is an important variation of an earlier New York statute which permitted municipalities to tax new middle-income housing projects on the basis of the assessments which existed prior to the new development.⁴

During the 1930's and 1940's many States other than New York enacted so-called "limited - dividend" programs which sought to encourage the construction of housing by granting tax abatement to private groups. In return for tax concessions the developers agreed to limit their annual profits, usually to about six per cent of their equality, and to maintain rents under an agreed upon ceiling. Most of these programs were directed towards the achievement of private redevelopment of substandard areas, and the housing sponsors were granted powers of eminent domain. However, little was accomplished under these programs, as tax abatement alone proved an insufficient inducement to private capital; the Federal "write-down" of land acquisition costs was subsequently evolved to elicit private interest in slum clearance activities.⁵ Nevertheless, the use of tax abatement remains available to municipalities. When used with other incentives it can be a powerful public instrument to encourage private development toward desired objectives.

The State of New Jersey recently developed a useful variation on the local tax abatement theme. It enacted legislation to permit municipalities to tax new construction in urban renewal project areas on the basis of a percentage of gross rental receipts. The rationale for this program was the recognition that new housing and non-residential developments in areas which are in the process of up-grading often experience difficulty in achieving occupancy rates sufficient to support the full tax burden. Thus the New Jersey law, locally referred to as the Fox-Lance Act,⁶ greatly facilitates redevelopment, as sponsors are protected from the immediate imposition of full local property taxes which do not reflect actual occupancy rates. A correlary feature of this program, and one which is common to most local tax abatement schemes, is the imposition of a ceiling on profits during the period in which tax abatement is granted.

Tax abatement formulae, designed to assist in the enlargement of the supply of standard middle-income housing, are constantly being reevaluated and revised. Of particular significance is the fact that they are being adopted to a wide range of objectives such as the encouragement of the rehabilitation of existing structures. New York City, for example, currently offers tax abatement on tenement properties which are up-graded to meet acceptable housing standards. The Commonwealth of Puerto Rico applies the same type of incentive system in historic areas to encourage the restoration of structures to their original Spanish colonial design, an objective which, in the eyes of the Puerto Rican government, is a desirable public objective related particularly to the development of tourism.

Where a local jurisdiction is anxious to encourage improved accoustical treatment of existing structures within the vicinity of airports, it should explore the possibility of using partial tax abatement to effect such improvements.

There is a considerable body of opinion which rejects the use of tax abatement to encourage the improvement of property, as

It grants no tax relief to the property-owner who maintains his property and benefits the property-owner who has allowed his property to deteriorate. It also violates the basic principle of the property tax; namely, that the incidence of the tax should be based upon the value of the property owned. It is also a hidden subsidy in that it seemingly encourages action without cost to the city. In fact, it is both a cost to the city and a cost, in terms of increased load, to the property-owners who have consistently maintained their property.⁷

The extension of favorable financial terms under the home improvement programs of the Federal Housing Administration is designed to encourage the private up-grading of residential properties without recourse to the manipulation of local assessment practices. However, the character of the home improvement problem is altered in those instances where airport facilities are either established or expanded within an already developed area. Here the problem is usually not one of up-grading structures to community-wide standards of acceptability, but one of improving properties to above normal standards to effect a reduction of the noise generated by the operations of a public airport. Where additional improvement costs must be incurred by the home owner in order to reduce the impact of fly-over noise, it would seem logical and fair that the extra cost of such unusual improvements should be assessed at a special low rate. This view would extend to existing and proposed non-residential and residential structures.

The use of tax abatement for stipulated time periods to attract industry is a widespread device which has been employed throughout the country for many years. States such as Mississippi have made it an important feature of their efforts to attract industry. While the employment of tax abatement for this purpose has, perhaps, only marginal significance in the effort to improve land use relationships adjacent to major airports, the knowledge that tax abatement is currently extended in various ways to effect development is of great importance when complex development problems are faced which require the application of a variety of approaches and techniques.

4. Extra-Territorial Jurisdiction

The levying of taxes is only permissible within the area of jurisdiction of the taxing unit. There is some legal evidence to suggest that, with specific legislative authorization, local units may extend their powers of taxation beyond their territory, but

the precedents are so circumscribed in their application as to constitute an irrelevancy. It is a valid generalization, therefore, that municipal taxing prerogatives, whatever the particular requirement and restrictions imposed by a State, extend only to the municipal boundaries. The same is true for counties and special districts.⁸ In addition to a tax levy on real property special districts may also collect various types of special charges to develop and maintain the particular facilities for which they have been granted responsibility.

The ability to draw tax support from the entire area served by a public activity which extends across several municipal boundaries is one of the reasons why special districts and, increasingly, counties, are so often employed to handle multi-jurisdiction problems.

The Huron-Clinton Metropolitan Authority was created in 1942 to provide major park areas for Wayne County and four surrounding counties comprising the Detroit metropolitan area. It has developed one of the most impressive regional park systems in the country. A principal strength of its operation has been its statutory ability to levy taxes up to a prescribed limit on real property within the five county area. Assessed values equalized by a state-wide formula provide the base for the real estate tax levy, which accounts for about nine-tenths of the Authority's revenues.

Aiming at preserving and developing recreational facilities in two river valleys and making them, as well as other recreational opportunities, readily accessible to a five-county population, the authority has constructed or is constructing a beach site, numerous parks, and an extensive connecting parkway 160 miles long. Furthermore, with its broad territorial jurisdiction, it can cooperate effectively with other park-and road-building agencies that are parts of smaller governments in the area.⁹

The ability of the agency to plan, construct, and maintain such a huge undertaking is directly attributable to its ability to anticipate a relatively steady income.

H. ESTIMATING EXPOSURE TO NOISE

The exposure of a given area on the ground to aircraft noise may be estimated by developing a Composite Noise Rating for each runway of an airport and plotting the noise level contours on a map.

This procedure was developed for the Federal Aviation Agency by Bolt, Beranek, and Newman, Inc., as published in "Land Use Planning Related to Aircraft Noise".¹ A pertinent extract of this document is reproduced on the following pages for the convenience of the reader.

1 October 1964 (This page is reproduced from report for FAA by Bolt Beranek and Newman
"Land Use Planning Related to Aircraft Noise."¹)

This report is interim in nature and the FAA makes no representations and assumes no responsibility regarding the matters and opinions contained therein.

SECTION B—DETAILED DESCRIPTION OF THE PROCEDURE

The step-by-step procedure for estimating community reaction to noise from military and civil aircraft operations is described and illustrated in this section. For ready reference, the six steps in the procedure are:

- Step One:* Obtain data on aircraft operations.
- Step Two:* Select noise contours.
- Step Three:* Determine perceived noise levels.
- Step Four:* Determine proper corrections for operational factors.
- Step Five:* Determine Composite Noise Rating.
- Step Six:* Estimate community response.

4. Step One: Obtaining Data on Aircraft Operations:

The first step in the procedure is to obtain a description of the aircraft operations occurring, or forecast to occur, at the airport in question. For flight operations, information is required by aircraft type on the total number of takeoffs and landings, on the percent utilization of each runway, and on the flight paths used. For runup operations the type of aircraft, location of the runup area, aircraft orientation, and the nature of the runup operation are the required information. One or two-engine piston and turboprop aircraft need not be considered because in almost all instances requiring evaluation they do not contribute materially in establishing final Composite Noise Rating contours.

A suggested format for collecting the required information on takeoff and landing operations and on runway utilization is shown in Table 1. This information should be gathered separately for the daytime (0700-2200) and the nighttime (2200-0700) periods. If an airport has several active runways but the problem at hand concerns only one residential area, data need not be gathered for runways whose operations obviously do not affect that area.

In recording takeoff and landing information in Table 1, use the arithmetical average number of

movements per time period (0700-2200 and 2200-0700) for the entire airport. The average values should be computed from long term data (*i.e.*, annual movements). If the number of daily movements shows pronounced variations according to a weekly or seasonal pattern, use the average number of movements over the period of maximum activity. For example, at a military base where activity is heavy on weekdays but very light on weekends, use the average over the five weekdays.

After arriving at a figure to represent the total number of operations on the entire airport for each type of aircraft, as explained above, obtain an estimate of the percentages of these movements which take place on each runway being considered. Record these estimates on Table 1 under the "Percent Runway Utilization" column for each aircraft type listed. In some cases an aircraft type may follow one of several flight paths after takeoff from, or preceding landing on, a given runway. In this event, consider each flight path as a separate "runway" (this situation is treated in Example 4).

A suggested format for collecting information on ground runup operations is shown in Table 2. The aircraft classes and associated engine power settings are entered in the first column. The number and duration of runups occurring for both daytime and nighttime periods are entered in the remaining columns. Table 2 should be filled out for each runup area. The number of runups shown should be the average number of single engine runups that occur for that particular runup area. The average should be computed from long term data, and allowances should be made for pronounced variations as previously discussed for flight operations. It is not necessary to record time during which water injection is used. However, estimates of afterburner use are required to allow appropriate separations between runup groups 1 and 2 or 2 and 3, respectively.

The number of flight or runup operations and the percent runway utilization need not be

(This page is reproduced from report for FAA by Bolt Beranek and Newman 1 October 1964
 "Land Use Planning Related to Aircraft Noise."¹)

Table 1. Suggested Format for Collecting Information on Takeoff and Landing Operations and on Runway Utilization.

Time Period _____						
Aircraft Category	Aircraft Type*	Average Number of Movements	Percent Runway** Utilization			
Civil Takeoffs	Turbojets—Trips under 2000 mi					
	Turbojets—Trips over 2000 mi					
	Turbofans—Trips under 2000 mi					
	Turbofans—Trips over 2000 mi					
	Four-engine piston					
	Four-engine turboprop					
	Helicopters (Sikorsky S-61, Vertol 107, and Vertol 44)					
Military Takeoffs	Jets—Flight group 1***					
	“ “ 2					
	“ “ 3					
	“ “ 4					
	“ “ 5					
	“ “ 6					
	“ “ 7					
	“ “ 8					
	“ “ 9					
	“ “ 10					
	Four-engine piston					
	Four-engine turboprop					
	Civil Landings	Four-engine piston and turboprop				
Turbojet and turbofan						
Helicopters—Vertol 44						
“ —Vertol 107, Sikorsky S-61						
Military Landings	All jets					
	Four-engine piston and turboprop					

See footnotes on next page.

FOOTNOTES TO TABLE 1

* Other designations for aircraft types are as follows: pure jet for turbojet; prop jet for turboprop; fan jet for turbofan; and conventional or propeller for piston engine.

** Runways are designated by their magnetic headings (with the last digit dropped). For example, Runway 9-27 is an east-west strip where takeoffs on R/W-9 are to the east, and landings on R/W-9 are from the west. Therefore, takeoffs on a given runway and landings on the reciprocal runway will usually pass over the same area. It is suggested that as many columns be allowed here as there are active runways to be considered.

*** See group classifications for individual military aircraft (Table 1-1, attachment 1).

Table 2. Suggested Format for Collecting Information on Runup Operations Conducted at Each Runup Area* on an Airport or Air Base.

Aircraft Category and Type		Average Number of Runups		Average Duration of Runup in Minutes	
		0700 to 2200	2200 to 0700	0700 to 2200	2200 to 0700
Civil	Turbojets at "trim" (or "part") and takeoff power				
	Turbofans at 75% thrust to full takeoff power				
Military	Runup group 1**				
	Runup group 2				
	Runup group 3				
	Runup group 4				

* When aircraft are oriented in more than one direction at a given runup location, consider each orientation as a separate "runup area" (see Example Four, paragraph 13, Section C).

** See group classifications for individual military aircraft (Table 1-2, attachment 1).

determined more closely than 20-25 percent. However, it is important to differentiate aircraft movements and runway utilizations by the aircraft types specified in Table 1, and runup operations by the classifications specified in Table 2.

When it is necessary to assess the effects of proposed or planned future operations, flight and runup information should be compiled from forecasts as far into the future as possible.

For civil airports, adequate information concerning current operations can usually be obtained from airport authorities, airline operations personnel, pilots and published schedules. Forecasts of future operations can be obtained from appropriate offices of the Federal Aviation Agency. On a military air base, the base commander and his designated representatives are the

best information sources. Detailed data on runway utilization are often not kept in routine records of civil or military airfields, but special studies are sometimes available to substantiate estimates.

To explain the application of each step of the procedure, we will carry a running illustration throughout the course of this section. Let us assume that we are interested in the perceived noise levels and corresponding estimated response for an area adjacent to Runway 17 at a civil airport. To simplify the example, let us confine our analysis to the 0700-2200 period.

Illustration of Step 1. We determine the following information by inquiry and complete Table 1 accordingly:

- a) Runway 17 is used only for takeoffs of turbofan and turbojet aircraft departing on trips greater than 2000 miles.

- b) For the entire airport, the average number of takeoffs of these aircraft types between 0700 and 2200 is 40 turbofans and 40 turbojets per day.
- c) The runway utilization for Runway 17 is approximately 55 percent for both types of aircraft.
- d) The departure flight path is straight out along the runway heading.

5. Step Two: Selecting Noise Contours:

After the information on airport operations required in Tables 1 and 2 has been collected, the next step in the procedure is to select the appropriate noise contours. Attachment 2 contains 5 sets of perceived noise level contours covering takeoffs and landings of military and civil jet and propeller aircraft and corresponding contours for selected civil helicopters, plus 3 sets of contours covering ground runups of turbojet and turbofan aircraft. These contours permit the determina-

tion of noise level in PNdB over a wide area beneath and off to the side of a flight path, or around an aircraft operating on the ground.

The appropriate contours for a particular problem can be selected by referring to Table 3; in this table, civil and military aircraft are separated, and each of these categories is divided into takeoffs, landings, and runups. Each of these operations is further divided by aircraft type. (The last column of Table 3 indicates corrections to be made to the designated contours depending on aircraft type and/or mission length; these corrections are made in Step 3.)

Illustration of Step 2. From the operational information collected in Step 1 and a study of Table 3 we find that the appropriate noise contours to use for takeoffs of these aircraft are those in Contour Set 1B.

Table 3. Chart for Selecting Noise Contours.

<i>Aircraft Category</i>	<i>Operation</i>	<i>Aircraft Type*</i>	<i>Contour Set</i>	<i>Correction to Contour</i>
Civil	Takeoffs	Turbojets—Trips under 2,000 mi.	1A	0
		Turbojets—Trips over 2,000 mi.	1B	0
		Turbofans—Trips under 2,000 mi.	1A	-5 PNdB
		Turbofans—Trips over 2,000 mi.	1B	-5 PNdB
		Four-engine piston	4	0
		Four-engine turboprop	4	-5 PNdB
		Helicopters (Sikorsky S-61, Vertol 107, and Vertol 44)	5A	0
	Landings	Turbojet	3B	0
		Turbofan	3B	0
		Four-engine piston and turboprop	3A	0
		Helicopters—Vertol 44	5B	-10 PNdB
		Vertol 107, Sikorsky S-61	5B	0
	Runups	Turbojet	6	0
		Turbofan	7	0

See footnotes at end of table.

Table 3—Continued.

Aircraft Category	Operation	Aircraft Type*	Contour Set	Correction to Contour
Military	Takeoffs	Jets—Flight group 1**	2A	+5 PNdB
		“ “ 2	2A	0
		“ “ 3	2A	-5 PNdB
		“ “ 4	2B	+5 PNdB
		“ “ 5	2B	0
		“ “ 6	2B	-5 PNdB
		“ “ 7	2C	0
		“ “ 8	2C	-5 PNdB
		“ “ 9	2C	-10 PNdB
		“ “ 10	2D	0
		Four-engine piston	4	0
		Four-engine turboprop	4	-5 PNdB
	Landings	All jets	3B	0
		Four-engine piston and turboprop	3A	0
	Runups	Runup group 1**	8	+5 PNdB
		“ “ 2	8	0
		“ “ 3	8	-5 PNdB
		“ “ 4	7	0

* For turbojet aircraft taking off, or during runup, the appropriate noise contours apply for water injection ("wet") as well as "dry" conditions.

** See group classifications for individual aircraft (Tables 1-1 and 1-2, attachment 1).

For runups, the selection of the proper contours is made in the same manner. In the case of civil operations, one must determine only whether turbojet or turbofan aircraft (or both) are to be considered. Table 3 shows that the corresponding contours are given in Contour Sets 6 and 7. Contour Set 8 is used for all military turbojet runups; for military turboprops, Contour Set 7 applies.

If an area is exposed to noise from aircraft at the beginning or in early stages of the takeoff roll, the determination of expected response is made by a combination of the above procedures. This method is illustrated in Example Four.

Attachment 3 outlines the procedures for constructing the perceived noise level contours for new types or classes of aircraft, as required.

6. Step Three: Determining Perceived Noise Levels:

After selecting the noise contours that correspond to the aircraft operations on the runways in question (and the appropriate runup contours, if runups are considered an important contributor to the noise levels in the residential area), the next step is to determine the perceived noise levels in PNdB for the area of interest. This is done by reading the perceived noise levels directly from the appropriate contour set and applying the corrections as noted in the last column of Table 3. Perceived noise levels must be determined for *each* of the operations noted in Tables 1 and 2 that is pertinent to the problem.

One way to determine the perceived noise levels for in-flight activity from the noise contours is to outline the runway, flight path, and the area(s) in question on a sheet of translucent (tracing) paper; this should be done to the *same scale* as the contours. This outline drawing can then be superimposed directly on the contours. For take-off operations, the beginning of the runway on the overlay drawing must coincide with the point for start of takeoff on the contours. For landings, the runway threshold on the overlay must coincide with the threshold on the contours. The perceived noise level at any given location can then be read directly.

Another way to determine perceived noise levels is to specify the location of the region with respect to the start of takeoff roll (for takeoffs) or runway threshold (for landings). For example, let us assume a particular community is located about 3000 ft. to the side of the takeoff path at a point 28,000 ft. from the start of takeoff roll. For takeoffs, the noise levels are then determined simply by reading the perceived noise levels from the appropriate noise contours (and applying corrections from Table 3) at this same location.

One complication that may arise in using the noise contours is that the takeoff path may be curved due to aircraft making a right or left turn after takeoff. For a straight-out takeoff, the contours in attachment 2 are used directly. However, if the flight path is curved, the takeoff contours must be modified to conform to the curved flight path. If we ignore the effect of the turn in flattening the aircraft's climb profile (and

hence in raising the noise levels somewhat), the contours need only be "bent" or curved so that their centerline coincides with the actual curved flight path. Figure 1 illustrates how the contours are "bent" to conform to a curved flight path.

In Figure 1 we see that at corresponding distances along, and at perpendicular distances to the side of the flight path, the contour values are the same for a straight-out path and a curved path. For example, at Point A nine miles from the start of roll on the curved flight path, the perceived noise level is the same as at Point A on the straight-out path, which is also at nine miles. Similarly, the perceived noise level at Point C, which is six miles out and one mile to the side of a straight-out flight path, is the same as at Point C six miles out along the curved flight path and one mile to the side of, and perpendicular to, the flight path. Other points on the curved noise contours can be located in a similar manner. Only enough points should be determined to enable one to draw the curved contours over the area under study.

Since only typical aircraft flight paths are normally used in this step, the resulting description of the expected response is valid only if the actual flight paths are reasonably represented by the selected average paths. The user of this procedure, especially in planning zoned areas around an airport, should consider the potential effect of typical deviations of aircraft from the selected average takeoff and landing paths used in the analysis procedure (see Section D).

Illustration of Step 3. In our running illustration, let us further suppose that the area is located approximately 20,000 feet from the start of takeoff roll and 2500 feet to the side of the flight path. In Step 2, we determined that the appropriate noise contours to use were contained in Contour Set 1B. We read from Contour Set 1B that the perceived noise level at this location is 105 PNdB. Applying the corrections noted in Table 3 (0 PNdB for turbojets and -5 PNdB for turboprops) we find that the perceived noise levels at this location are:

Turbojets—105 PNdB.

Turboprops—100 PNdB.

7. Step Four: Determining Corrections for Operational Factors:

The next step in the procedure is to apply corrections to the perceived noise levels determined by Step 3 for other factors important in

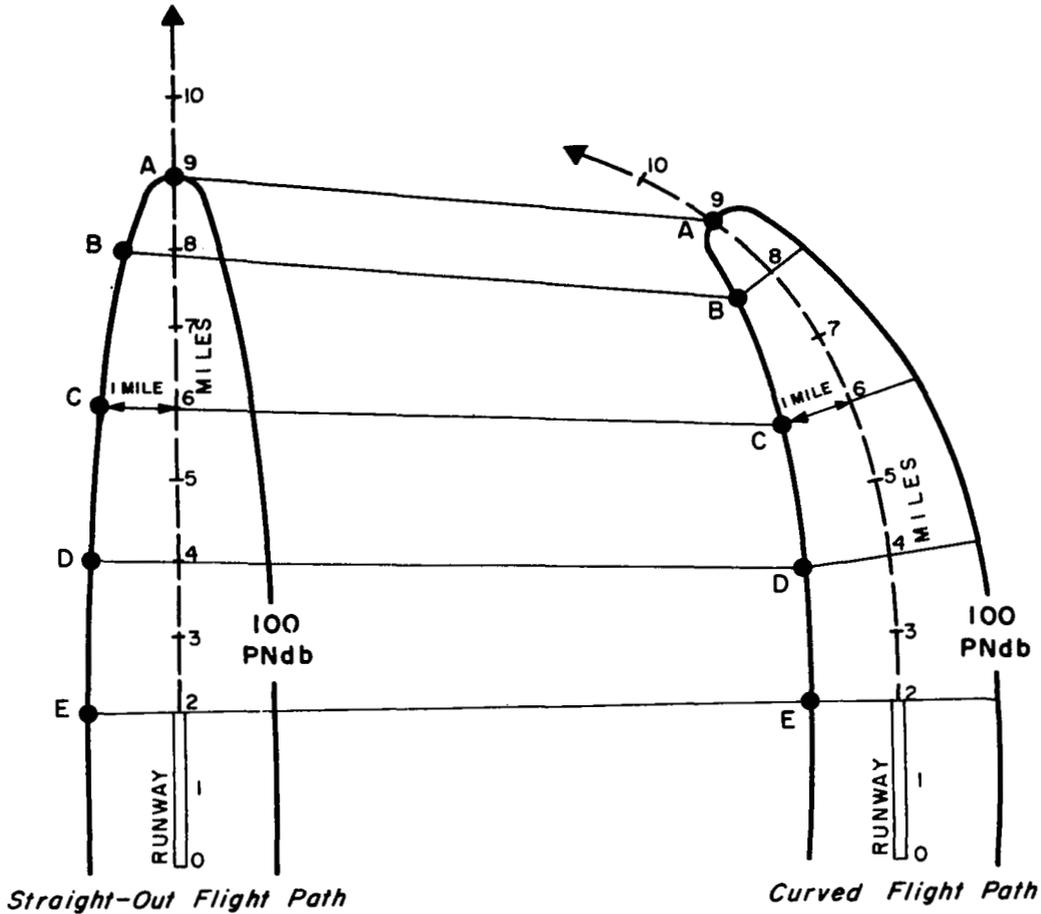


Figure 1. Illustration of Adapting Perceived Noise Level Contours to Curved Flight Path.

affecting reaction to aircraft noise. For takeoffs and landings these factors are: number of operations, runway utilization, and time of day. The corrections for these factors are given in Table 4. For runup operations, the important factors are: number of runups, duration of runups, and time of day. The corrections for these factors are given in Table 5.

Illustration of Step 4. To show how corrections for operational factors are determined, let us continue

with our running illustration. In step 1, we found that there are a total of 40 turbojet takeoffs and 40 turboprop takeoffs per day during the 0700-2200 period; the utilization of Runway 17 is about 55 percent. The correction from Table 4 for the number of operations is +5 for both types of aircraft. The correction for runway utilization is 0 for both types. Finally, the time of day was restricted here to the 0700-2200 period, so the applicable correction is 0. In summary, the total of the correction numbers for turbojet operations is +5, and for turboprop operations is +5.

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Table 4. Operational Corrections to Apply to Perceived Noise Levels for Takeoffs and Landings.

<i>Number of Takeoffs or Landings per Period</i>		<i>Correction</i>
<i>Day (0700-2200)</i>	<i>Night (2200-0700)</i>	
Less than 3*	Less than 2	-10
3-9	2-5	-5
10-30	6-15	0
31-100	16-50	+5
More than 100	More than 50	+10
<i>Percent Runway Utilization</i>		<i>Correction</i>
31-100		0
10-30		-5
3-9		-10
Less than 3		-15
<i>Time of Day**</i>		<i>Correction</i>
0700-2200		0
2200-0700		+10

* If the average number of operations for an aircraft type is less than one per time period, that aircraft type should not be considered in the analysis.

** In general, the ratio of daytime-to-nighttime operations is such that daytime operations determine the Composite Noise Ratings at airports. Only when the nighttime activity is disproportionately high will the nighttime correction affect the Composite Noise Rating.

Table 5. Operational Corrections to Apply to Perceived Noise Levels from Engine Runups.

Number of Single Engine Runups per Period		Correction
Day (0700-2200)	Night (2200-0700)	
5 or less	3 or less	0
More than 5	More than 3	+5
Duration of Runup (in minutes)		Correction
Less than 1		-5
1 to 5		0
More than 5		+5
Time of Day		Correction
0700-2200		0
2200-0700		+10

8. Step Five: Determining Composite Noise Rating:

The Composite Noise Rating (CNR) for each type of flight operation is computed by adding algebraically the total of the correction numbers as determined in Step 4 to the perceived noise level in PNdB as determined in Step 3.

Illustration of Step 5:

For turbojet takeoffs the Composite Noise Rating is:

$$\text{CNR} = 105 \text{ PNdB} + (+5) = 110$$

For turbofan takeoffs it is:

$$\text{CNR} = 100 \text{ PNdB} + (+5) = 105$$

At this point in the analysis, a CNR will result for each takeoff and landing operation being considered. From these various values one CNR must be chosen to apply to the area under study for all flight operations. Since both takeoffs and landings have been divided into various categories (see Table 3) and since the noise perceived at any given location will frequently come from operations on several runways and/or flight paths, provision must be made to recombine CNRs of comparable value. Only those CNRs that are within 3 units of the maximum CNR need be considered. If there are three or more CNRs fulfilling this requirement, add 5 units to the highest one to determine the CNR that applies for all flight opera-

tions; if there are less than three, the highest CNR applies.

Illustration of Step 5 (continued):

In our illustration we found that the CNRs for the two types of takeoff operations were 110 and 105. According to the rules stated above, the CNR for takeoffs at the location in question is 110. Had there been three or more values of CNR between 107 and 110, the resultant CNR would have been 115.

If runup operations were also involved, their analysis would proceed in a similar manner. The appropriate runup contours would be employed and corrections from Table 5 would be applied to the perceived noise levels. If several runup operations were involved, a Composite Noise Rating would be determined for each one, and the highest CNR selected. If there were three or more CNRs within 3 units of the maximum CNR, 5 units would be added to the highest to determine the CNR for all runup operations. This CNR would not be directly combined or compared with the CNR for flight operations. As will be seen later, however, the estimates of community response which correspond to the controlling CNRs for flight and runup operations are combined or compared to arrive at the estimated overall response of a community to all aircraft operations.

9. Step Six: Estimating Community Response:

On the basis of case histories involving aircraft noise problems at various military installations and civil airports, an empirical relationship has been developed between Composite Noise Ratings and the expected response of residential communities. This relationship is given in Table 6. As a consequence of the various degrees of expected community response, the geographical area in the vicinity of an airport can be characterized by three response zones: Zone 1, Zone 2, or Zone 3. It is stressed that these expected responses apply only to residential areas within the respective zones.

Note that one Composite Noise Rating Scale in Table 6 applies to runups and another to flight operations. This emphasizes again (as in Step five) that runups must be analyzed separately from flight operations. In the practical application of this procedure, therefore, we can derive two separate descriptions of community response

for one particular geographic location. The more severe description (e.g., Zone 2 description as opposed to Zone 1 description) will, of course, represent the community response at that location to all operations. In Example 4, Section C, this combination of the zones describing flight operations with those describing runup operations is demonstrated.

Illustration of Step 6. For the Composite Noise Rating of 110 for takeoffs, as determined in Step 5, we see that the area in question lies in Zone 2 and that the corresponding expected community response is described as:

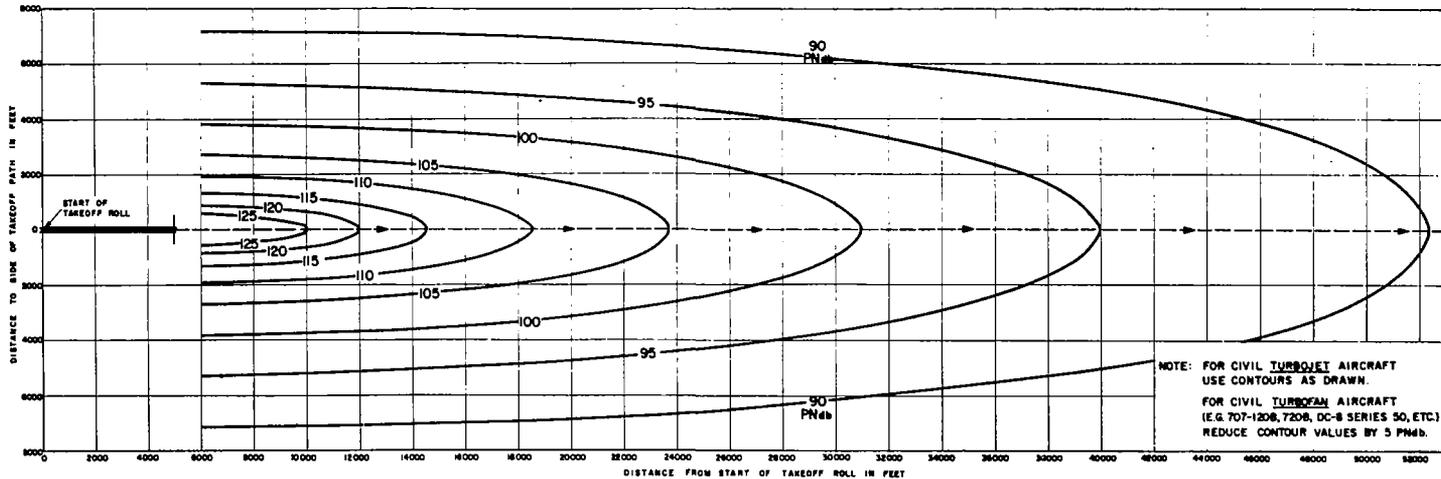
"Individuals may complain, perhaps vigorously. Concerted group action is possible."

This sixth step completes the procedure. The end product of this analysis is a description of the average response we can expect from the residents of communities lying in the three zones derived from the procedure. Several factors which may modify this response in a particular community situation are discussed in Section D.

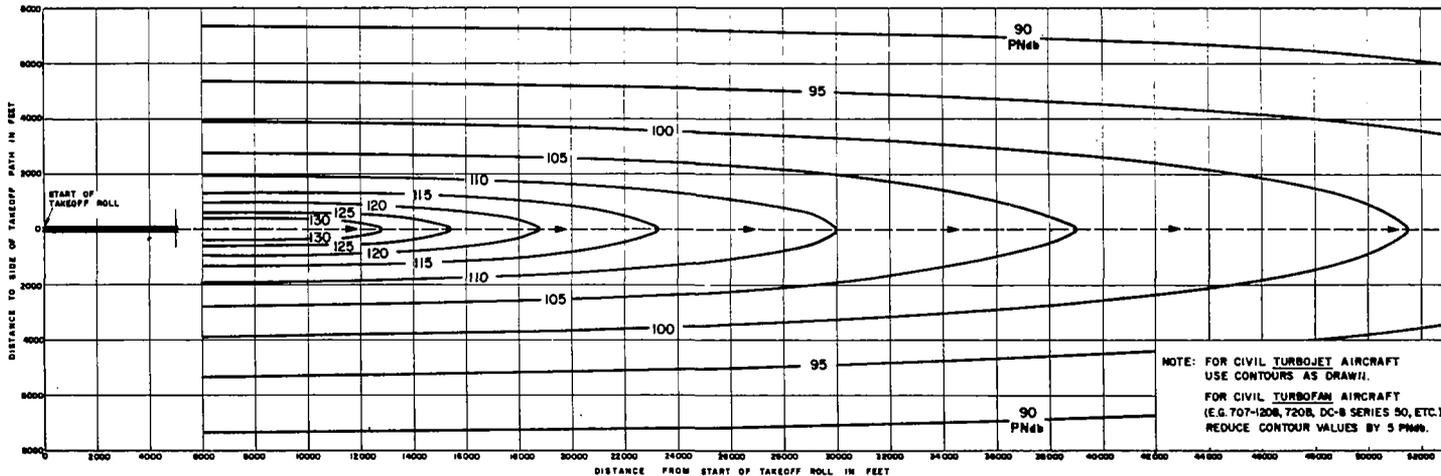
Table 6. Chart for Estimating Response of Residential Communities from Composite Noise Rating.

<i>Composite Noise Rating</i>		<i>Zone</i>	<i>Description of Expected Response</i>
<i>Takeoffs and Landings</i>	<i>Runups</i>		
Less than 100	Less than 80	1	Essentially no complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents.
100 to 115	80 to 95	2	Individuals may complain, perhaps vigorously. Concerted group action is possible.
Greater than 115	Greater than 95	3	Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected.

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(A) TRIP LENGTH LESS THAN 2000 MILES.



(B) TRIP LENGTH MORE THAN 2000 MILES.

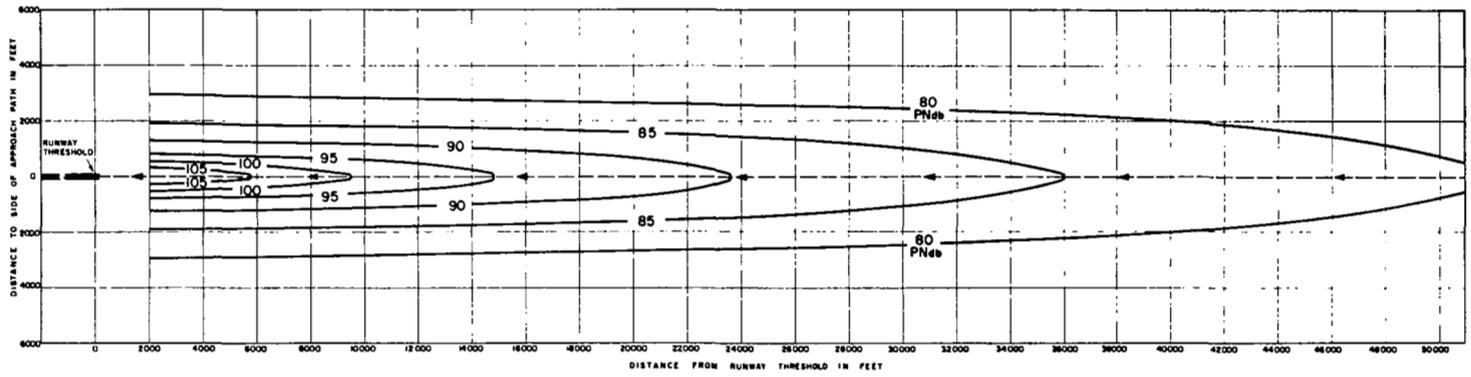
PERCEIVED NOISE LEVEL CONTOURS FOR TAKEOFFS OF CIVIL JET TRANSPORTS.

CONTOUR SET I

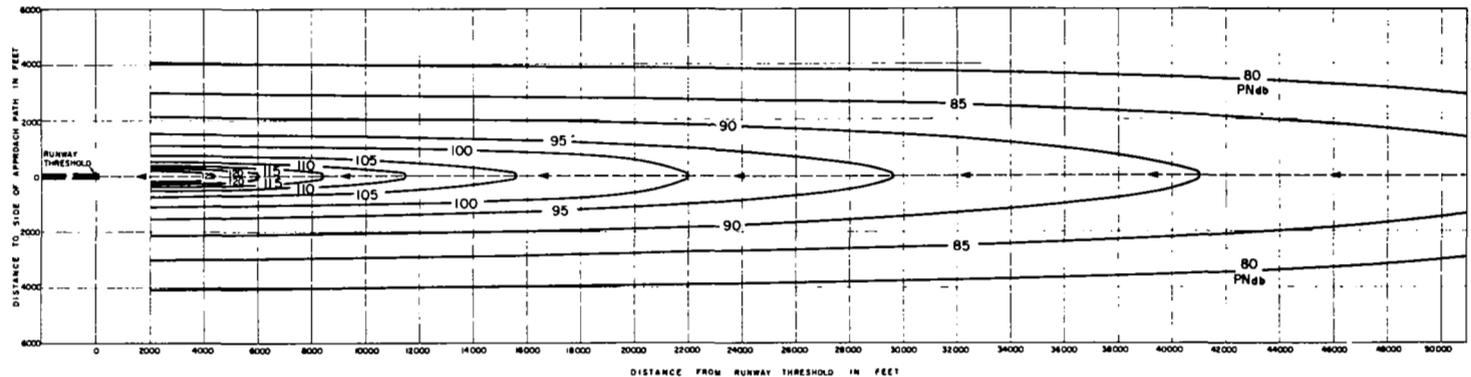
29

Attachment 2

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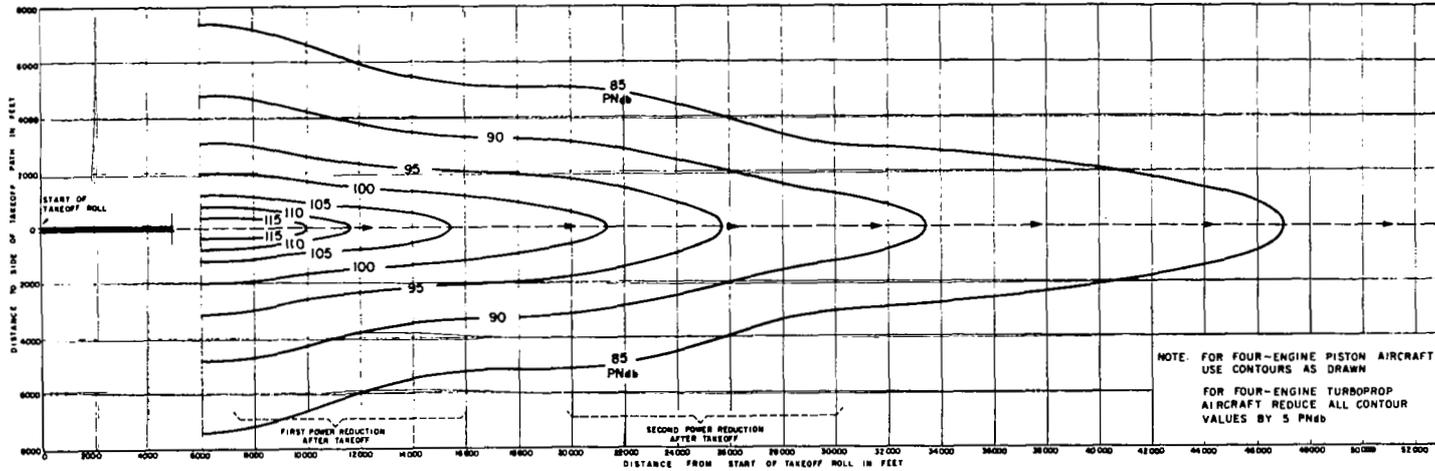
(A) FOUR-ENGINE PISTON AND TURBOPROP AIRCRAFT.



(B) TURBOJET AND TURBOFAN AIRCRAFT.

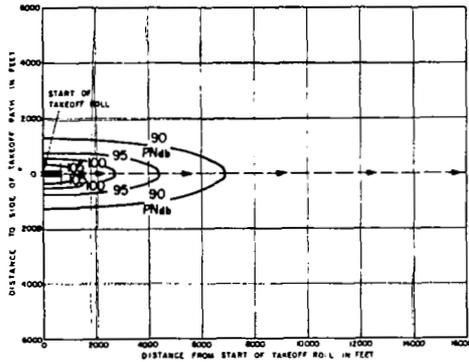
PERCEIVED NOISE LEVEL CONTOURS FOR CIVIL AND MILITARY LANDINGS.

CONTOUR SET 3

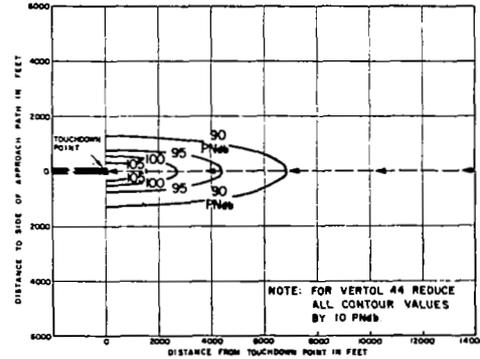


PERCEIVED NOISE LEVEL CONTOURS FOR TAKEOFFS OF FOUR-ENGINE PISTON AND TURBOPROP AIRCRAFT.

CONTOUR SET 4



(A) TAKEOFFS



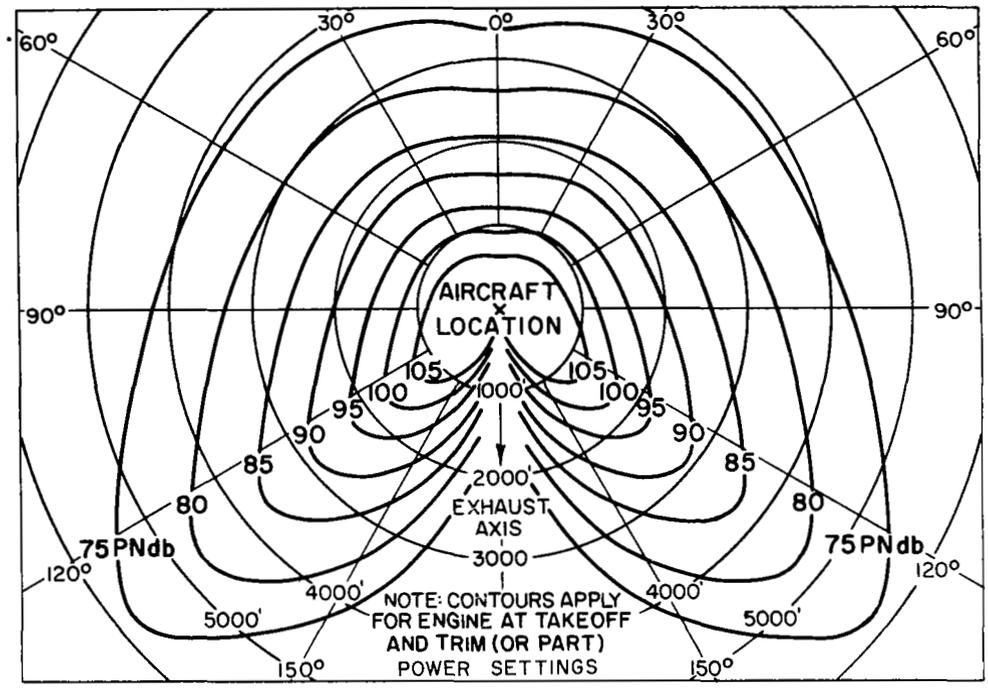
(B) LANDINGS

PERCEIVED NOISE LEVEL CONTOURS FOR TAKEOFFS AND LANDINGS OF SIKORSKY S-61, VERTOL 44, AND VERTOL 107 HELICOPTER OPERATIONS AT AIRPORTS.

CONTOUR SET 5

1 October 1964

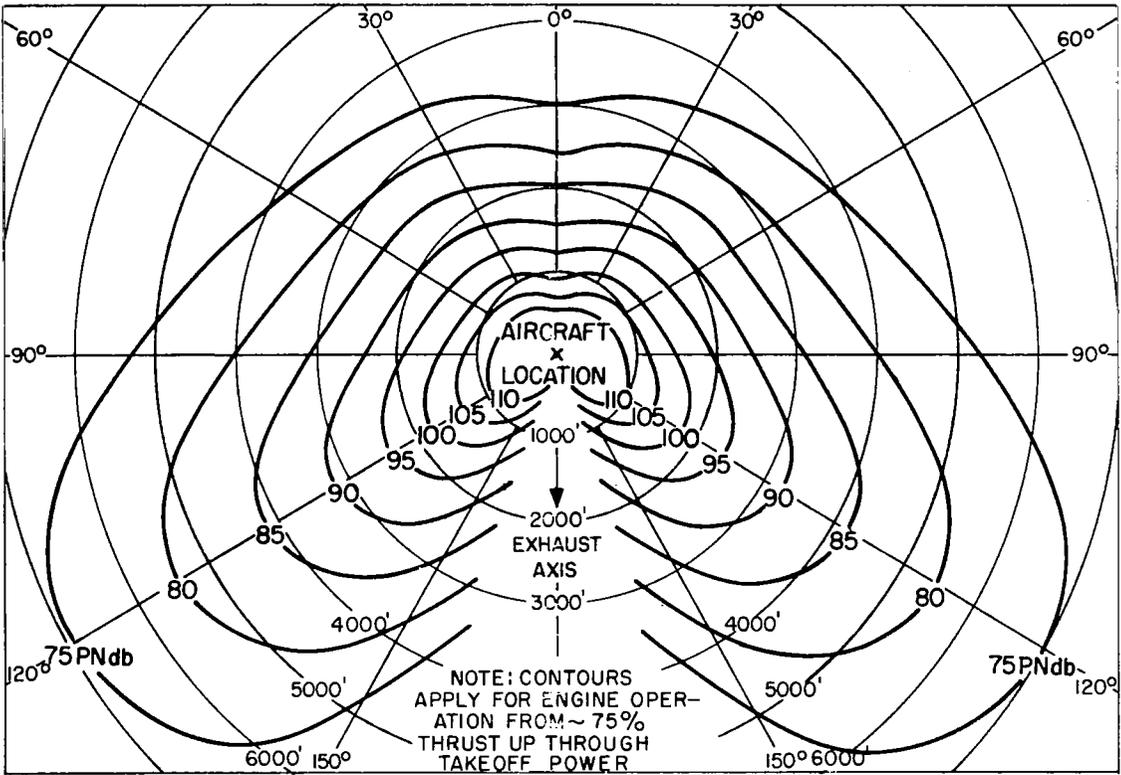
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PERCEIVED NOISE LEVEL CONTOURS - ONE ENGINE RUNUPS.
CIVIL JET AIRCRAFT - NON-TURBOFAN ENGINES.

CONTOUR SET 6

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PERCEIVED NOISE LEVEL CONTOURS - ONE ENGINE RUNUPS.
CIVIL AND MILITARY JET AIRCRAFT WITH TURBOFAN ENGINES.

CONTOUR SET 7

I. ACOUSTICAL CONTROL IN STRUCTURES

The average building offers substantial noise reduction if the windows are closed. Additional noise proofing can be added at moderate cost. Satisfactory interior noise levels can therefore be maintained even in severely noise affected areas. Airconditioning or mechanical ventilation is necessary. There appears to be no way of protecting outdoor activities from noise. The market value of properties seems to be unaffected in noise zones of less than 112 PNdb.

1. Costs of Noise Reduction

Building noise reduction calculations performed by Arde, Inc. indicate that the average wood frame building will have a noise reduction of about 30 decibels with closed windows. The interior noise level will then be acceptable as long as the exterior noise is not more than 30 db above the desired interior noise level.

Cost estimates by Arde, Inc. indicate that sound proofing can be installed in existing structures at a cost of about 1% of the building base cost per decibel of extra noise reduction up to about 10 db or 40 db total noise reduction. Storm windows will improve noise reduction by about 2 db at a cost of about 2 per cent of the base cost of the structure. To obtain more than 10 db additional noise reduction will require basic changes in the structure rather than simple add-ons.

The cost of building a soundproof one or two story structure is also about 1% of the cost of a basic frame structure per decibel of extra noise reduction. Since the building is designed to be soundproof to begin with, the total noise reduction is not limited to 10 db.

An average multistory commercial building has a noise reduction of 35 db. Additional noise reduction will cost about 1-1/2% of the base cost per db.

Since windows must be closed for noise reduction, extractor fans or air conditioning are required. Air conditioning will cost about 10% of the building base cost; extractor fans about 1% of the building base cost.

This information can be used to estimate the cost of soundproofing existing structures in noise affected areas and to estimate the extra cost of building in noise affected areas.

These figures are based on conventional building practices which have been developed with only secondary consideration of noise proofing needs. Research on noise proofing would undoubtedly generate new construction techniques giving better noise reduction at lower cost.

The noise and cost reduction figures were determined in the following manner:

a. Basic architectural designs were prepared for three common detached residential types of structure and for a multi-story commercial building. The plans are shown in Figures 4, 5, 6, 7, 8 and 9; construction details were obtained from a standard reference.¹ Various combinations of structural materials and interior finishes are described in Tables 5 and 7. The cost of each structure was estimated using a standard construction estimating handbook.²

b. The noise reduction of each structure was calculated as described in Section 7, below, entitled "Noise Reduction Calculations".

c. Various sound proofing modifications were added to the structures as shown in Tables 5, 6, and 7. The cost and noise reduction of each modified structure was calculated in the same manner as for the basic structure.

All of the calculations are based on the assumption that the building surfaces are free from cracks and that there are no sound flanking paths around the surfaces. Noise attenuation can be severely reduced if sound can enter a building through cracks around poorly fitted doors and windows or around pipes and wiring. The presence of flanking paths such as air ducts through which sound can enter a structure without being actually transmitted by the wall or ceiling surfaces will also reduce the amount of attenuation possible.

2. Noise Reduction Required

Table 1 presents a list of noise levels for various activities which most people will find acceptable. Since definition of acceptable noise levels is a personal thing, many people will consider the noise levels in Table 1 unacceptable, while others will accept even higher levels.

The amount of noise reduction required by a building is the difference between the acceptable noise level and the composite noise rating of the building location. Table 1 shows the external noise levels for which an average structure will have an acceptable internal noise level. Table 1 also shows the allowable external noise level if 10 db of soundproofing is added.

The Table does not present allowable external noise ratings for the activities listed under special uses since the buildings for these activities vary so greatly one to the other that no meaningful average noise reduction can be projected.

Table 2 shows the amount and cost of the soundproofing required to maintain acceptable internal noise levels for buildings in various external noise zones.

3. Limitation of the Effectiveness of Acoustic Treatment for Residences

Acoustic treatment is not effective for uses which involve outdoor as well as indoor activities. This is true of residences whose occupants are likely to be outdoors in good weather. Once outside, the occupants will receive the full impact of the aircraft noise. We must accept the fact that some of the amenities of outdoor living will be lost in noise affected areas.

4. Allocation of Costs for Acoustic Treatment

Property owners who install acoustic treatment to shut out the noise of jet aircraft claim they should be compensated for the expense by those who benefit from the flight activity. The direct beneficiaries are travellers, shippers, the airport and the aircraft operators. The community benefits indirectly from the commercial activity generated by the airport; the property owner benefits directly from his access to rapid transportation, and indirectly from the general growth of commercial activity.

The British government has recently initiated a policy that each of these parties should bear a share of the cost. ³ On March 10, 1965, the Aviation Minister announced a program under which a grant of up to \$280 would be made to each home owner toward soundproofing homes in the western outskirts of London near the London airport. In making this offer, the Government accepted the principle that noise made near an airport is a responsibility of the whole community. The Government expects to recover some of the grant from the airport authorities and the airlines so that the cost of such soundproofing will be distributed among the airport, the community and the property owner.

The Supreme Court of the State of Washington has ruled in *Martin vs the Port of Seattle* (1964) that a property owner should be compensated, but only to the extent of the loss, if any, of the market value of his property. ⁴ This may be more or less than the cost of soundproofing. The extent of such loss has not yet been determined.

5. Effect of Airport Noise on Property Values

According to a Port of New York Authority report, airports do not affect the market value of surrounding properties adversely. ⁵ In fact, in some cases, proximity to the airport was the apparent reason for higher prices than would be otherwise justified. ⁶

In Des Moines, Iowa, a recent reappraisal of property values gave no adverse allowance to properties near the Des Moines Airport. As mentioned above, the Des Moines authorities did suffer a 20% loss on properties purchased and resold in the clear zone just beyond the runways. The New York City areas considered were in noise zones of 112 PNdb or less. We can tentatively conclude that the market price will not be adversely affected until the noise level is somewhere between 112 and 120 PNdb.

It is clear that to a substantial part of the public, particularly to those who are less sensitive to noise than others, the advantage of being close to air transportation and to the commercial activities generated by an airport, adequately compensates for the attendant noise.

6. Tables and Charts

Tables 3 and 4 summarize the installed cost and noise transmission loss of a variety of wall, floor and ceiling constructions. The correlation between cost and transmission loss is not significant. For example, 12" concrete block at \$1.34 per square foot is just as good as fieldstone veneer at four times the cost. This is not surprising since the various construction techniques were devised for aesthetic and structural consideration rather than for acoustical purposes.

Costs are estimated using Reference 7. Noise transmission loss is calculated in accordance with Equation 3 in the Handbook of Noise Control.⁷

The construction costs and extra noise reduction costs mentioned in this section were computed for three residences and a multistory commercial building. Floor plans of the residences are shown on Figures 4 through 8. The floor plan of the office building is shown on Figure 9.

Table 5 shows the add-on modifications considered to soundproof a basic frame building. The cost and noise reduction of the basic house and the modified house are shown on Figure 1.

Table 6 lists eight different types of constructions investigated for cost and noise reduction. Figure 2 shows the relation between noise reduction and the lowest cost at which a given level of noise reduction can be achieved. The structures considered ranged from the basic frame house to a house with double walls 24" overall thickness and double glazed windows with 6" air space.

The cost and noise reduction for a five-story office building were computed for three types of construction. Table 7 specifies the types of construction considered in order of increasing noise reduction. Figure 3 shows the cost and noise reduction for each type of construction.

7. NOISE REDUCTION CALCULATIONS

a. Procedure

In general, noise reduction, N, can be expressed as:

$$N = TL - 10 \log_{10} \left[\frac{S_t}{S_r \left(\frac{a}{1-a} \right)} + .25 \right] \quad (1) \quad (\text{ref 9, page 160})$$

where TL = Average transmission loss - db

S_t = Total transmitting surface area

S_r = Total area of receiving room surface

a = Average sound absorption coefficient

Transmission loss in the classical form is:

$$TL = 10 \log_{10} \frac{1}{T} \quad (\text{ref.7, page 20-3}) \quad (2)$$

where T = Transmittivity ratio

= Ratio of transmitted sound energy to
incident sound energy.

For a homogeneous structure, TL can be expressed by
the mass law, i.e.:

$$TL = 23 + 14.5 \log w \quad (3)$$

where w = Weight of structure in pounds per square
foot of surface. Reference ⁷, Page 20-7,
Equation 20.5

The average T and a values required to assess the
attenuation characteristics of an enclosure are
obtained from:

$$a = \frac{\sum_{n=1}^n a_n A_{Rn}}{\sum_{n=1}^n A_{Rn}} \quad (4)$$

where A_{Rn} = Component receiving area; $S_r = \sum_{n=1}^n A_{Rn}$

a_n = Absorption coefficient of receiving area, and

$$T = \frac{\sum_{n=1}^n T_n A_{Tn}}{\sum_{n=1}^n A_{Tn}} \quad (5)$$

where A_{Tn} = Component transmitting area; $S_t = \sum_{n=1}^n A_{Tn}$

T_n = Transmittivity ratio of transmitting area

The various values of T_n and a_n were taken directly from the references listed under Acoustical Control or computed by methods set forth in these references.

Substituting in Equation (1) we obtain:

$$N = -10 \log_{10} \left[T \left(\frac{\sum_{n=1}^n A_{Tn}}{\sum_{n=1}^n A_{Rn}} \left(\frac{1-a}{a} \right) + .25 \right) \right] \quad (6)$$

Sample N calculations for the living room of a typical colonial residence follow.

b. Noise Reduction of Colonial Living Room

Component	a_n	A_{Rn}	A_{Tn}	T_n	$a_n \cdot A_{Rn}$	$T_n A_{Tn}$
Window	$a_6 = .02$	78	78	$1.78 \cdot 10^{-3}$.138
Front Exterior Wall	$a_2 = .05$	82	82	$4.17 \cdot 10^{-4}$.034
Side Exterior Wall	$a_2 = .05$	108	108	$4.17 \cdot 10^{-4}$	5.4	.045
Interior Wall	$a_3 = .05$	226			11.3	
Ceiling	$a_1 = .03$	270			8.1	
Carpeted Floor	$a_4 = .60$	270			162	
Heavy Drapes	$a_{13} = .46$	160			74	
Sum		1034	268		260	.218

$$a = 260 + 1034 = .251$$

$$T = .218 + 268 = 8.136 \times 10^{-4}$$

Substituting in Equation (6)

$$N = -10 \log 8.136 \cdot 10^{-4} \left[\frac{268}{1034} \cdot \frac{.749}{.251} + .25 \right]$$

$$N = 30.8 \text{ db}$$

d. Noise Reduction with Storm Windows

The utilization of no-leak storm windows is equivalent to the installation of fixed double glazed windows. The transmission loss for the double glaze system was calculated from mass law consideration to be about 3.5 db higher than its single glass counterpart. However, since the receiving room is slightly reverberant, the entire transmission loss cannot be reflected in the noise reduction. Recalculating with storm windows we obtain a noise reduction of 32.7 or 1.9 decibels more than without storm windows.

TABLE 1

ACCEPTABLE EXTERIOR NOISE LEVELS FOR VARIOUS ACTIVITIES BASED ON
AVERAGE NOISE REDUCTION BY BUILDING

<u>Activity</u>	<u>Acceptable Interior Noise Level (PNdb)*</u>	<u>Acceptable Exterior CNR** (without modification)</u>	<u>Acceptable Exterior CNR** with 10 db extra Noise Reduction</u>
INDUSTRIAL (7)			
Apparel	85	115	125
Printing	80	110	120
Food Processing	80	110	120
Metal Working	90	120	130
OFFICES (7)			
Private-one floor	50	80	90
Private-multifloor	50	85	95
General-one floor	60	90	100
General-multifloor	60	95	105
HOTEL (11)	60	90	100
SCHOOL (7)	55	85	95
STORE (7)	70	100	100
RESIDENCE (11)	60	90	100
SPECIAL USES (9)			
Concert Hall	40		
Theater	50		
Church	45		
Hospital	50		
Arena	70		

*Noise level in PNdb obtained by converting noise levels noted in references from db to PNdb. (References designated by numbers in parentheses)

**CNR = Composite Noise Rating

TABLE 2

COST OF SOUND PROOFING IN HIGH NOISE AREAS

NOTE: (A) Acceptable Interior Noise Level (PNdb)
 (B) Extra Noise Reduction Required (db)
 (C) Cost per square foot (dollars)

<u>Composite Noise Rating Zone:</u>		<u>120 db</u>		<u>110 db</u>		<u>100 db</u>	
<u>Activity</u>	<u>(A)</u>	<u>(B)</u>	<u>(C)</u>	<u>(B)</u>	<u>(C)</u>	<u>(B)</u>	<u>(C)</u>
INDUSTRIAL							
Apparel	85	5	1.00	--	--	--	--
Printing	80	10	2.00	--	--	--	--
Food Processing	80	10	2.00	--	--	--	--
Metal Working	90	--	--	--	--	--	--
OFFICES							
Private-One Floor	50	40	8.00	30	6.00	20	4.00
Private-Multifloor	50	35	14.00	25	10.00	15	6.00
General-One Floor	60	30	6.00	20	4.00	10	4.00
General-Multifloor	60	25	10.00	15	6.00	5	2.00
RESIDENCE	60	30	6.00	20	4.00	10	2.00
HOTEL	60	30	12.00	20	8.00	10	4.00
SCHOOL	55	35	7.00	25	5.00	15	3.00
STORE	70	20	4.00	10	2.00	--	--

TABLE 3

EXTERIOR WALL NOISE REDUCTION AND COST CHARACTERISTICS

NOTE: W - Weight of wall per square foot
 T.L. - Average transmission loss db.
 C. - Cost in dollars per square foot
 EC - Effective cost in dollars per 100 square feet of wall per db transmission loss.
 CB - Common Brick
 FLP - Furring, Lath and Plaster
 HB - Hollow Concrete Block
 HCB - Hollow Cinder Block
 SB - Solid Concrete Block
 PB - 1/2" Plaster Board
 GP 1 - 5/8" Gypsum Plaster on Masonry
 GP 2 - 3/4" Gypsum Plaster on Metal Lath

<u>TYPE CONSTRUCTION</u>	<u>W</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
<u>I. Cinder Block</u>				
A. Basic Wall-Hollow				
1. 4"	16.7	28.8	0.55	1.91
2. 8"	33.4	32.5	0.77	2.37
3. 12"	50.0	36.3	1.33	3.69
B. A + GP-1				
1. 4"	21.7	42.3	0.70	1.65
2. 8"	38.4	43.0	0.92	2.13
3. 12"	55.0	46.0	1.48	3.21
C. A + FLP				
1. 4"	24.2	41.5	0.78	2.12
2. 8"	40.9	44.0	1.00	2.27
3. 12"	57.5	46.5	1.56	3.35
<u>II. Concrete Blocks (Dense)</u>				
A. Basic Wall-Hollow				
1. 6"	35.0	39.0	0.96	2.46
2. 8"	46.6	46.0	2.08	2.34
3. 12"	70.0	47.0	1.22	2.59
B. Basic Wall-Solid				
1. 6"	55.5	44.0	1.01	2.29
2. 8"	74.0	47.0	1.12	2.38
3. 12"	111.0	51.0	1.34	2.62

TABLE 3 (Cont'd.)

<u>TYPE CONSTRUCTION</u>	<u>W</u>	<u>T.L.</u>	<u>C.</u>	<u>EC</u>
C. A + GP-1				
1. 6"	40.0	43.0	1.11	2.58
2. 8"	51.6	46.0	1.23	2.67
3. 12"	75.0	47.0	1.37	2.91
D. B + GP-1				
1. 6"	60.5	46	1.16	2.52
2. 8"	79.0	50	1.27	2.58
3. 12"	116.0	51	1.51	2.96
E. A + FLP				
1. 6"	42.5	45.5	1.19	2.61
2. 8"	54.1	46.5	1.31	2.81
3. 12"	77.5	50.0	1.45	2.90
F. B + FLP				
1. 6"	63.0	47.0	1.24	2.63
2. 8"	81.5	50.0	1.35	2.65
3. 12"	117.5	51.0	1.59	3.11
III. <u>Brick (Common)</u>				
A. Basic Wall				
1. 4"	35.0	44.0	1.07	2.43
2. 8"	74.0	48.0	1.94	4.04
B. A + GP-1				
1. 4"	40.0	43.0	1.22	2.83
2. 8"	79.0	50.0	2.09	4.18
C. A + FLP				
1. 4"	42.5	45.0	1.30	2.88
2. 8"	81.5	50.0	2.17	4.34
IV. <u>Clay Tile</u>				
A. Basic Wall				
1. 4"	22.5	41.0	0.55	1.34
2. 6"	32.0	42.0	0.61	1.45
3. 8"	38.0	43.0	0.87	2.02
B. A + GP-1 (IS)				
1. 4"	27.5	42.0	0.70	1.66
2. 6"	37.0	43.0	0.76	1.76
3. 8"	43.0	46.0	1.02	2.21

TABLE 3 (Cont'd.)

<u>TYPE CONSTRUCTION</u>	<u>W</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
C. A + FLP				
1. 4"	30.0	42.0	0.77	1.80
2. 6"	39.5	44.0	0.84	1.90
3. 8"	45.5	46.0	1.10	2.39
V. <u>Pre-Cast Concrete Walls</u>				
A. Basic Wall - 4" (Lightly Reinforced)	42.0	46.5	3.10	6.66
VI. <u>Brick Veneer on Concrete</u>				
A. 4" Brick + 8" HB	81.6	50.4	2.15	4.26
B. 4" Brick + 8" SB	109.0	51.3	2.19	4.26
C. A + GP-1 (1S)	86.6	50.5	2.30	4.55
D. B + GP-1 (1S)	114.0	51.4	2.34	4.55
E. A + FLP (1S)	89.1	50.6	2.38	4.70
F. B + FLP (1S)	116.5	51.5	2.42	4.69
VII. <u>Brick Veneer on Cinder Block</u>				
A. 4" Brick + 8" HCB	68.4	47.3	1.84	3.89
B. A + GP-1 (1S)	73.4	47.5	1.99	4.18
C. A + FLP (1S)	75.9	50.1	2.07	4.13
VIII. <u>Stone (Sandstone or Bluestone) with Varied Masonry)</u>				
A. 4" Stone + 8" HB	95.6	50.8	5.46	10.74
B. 4" Stone + 8" SB	123.0	51.6	5.51	10.67
C. 4" Stone + 8" HCB	82.4	50.4	5.27	10.45
D. 4" Stone + 8" CB	123.0	51.6	6.44	12.43
E. A + GP-1 (1S)	100.6	51.0	5.61	11.00
F. B + GP-1 (1S)	128.0	51.8	5.66	10.92
G. C + GP-1 (1S)	87.4	50.6	5.42	10.71
H. D + GP-1 (1S)	128.0	51.8	6.59	12.72
I. A + FLP (1S)	103.1	51.0	5.69	11.15
J. B + FLP (1S)	130.5	52.0	5.74	11.03
K. C + FLP (1S)	89.9	50.7	5.50	10.84
L. D + FLP (1S)	130.5	51.8	6.67	12.87

TABLE 3 (Cont'd.)

<u>TYPE CONSTRUCTION</u>	<u>W</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
<u>IX. Wood Frame with Varied Exteriors</u>				
A. Shingle Siding (Wood)				
1. With GP-2	12.0	35.8	1.14	3.18
2. With PB	10.0	33.8	0.94	2.78
B. Stucco Facing				
1. GP-2	20.0	38.5	0.85	2.20
2. PB	18.0	38.0	0.65	1.71
C. Brick Veneer - 4"				
1. GP-2	45.0	46.0	2.78	6.04
2. PB	43.0	45.8	2.58	5.63
D. Stone Veneer - 4"				
1. GP-2	59.0	46.8	5.05	9.26
2. PB	57.0	46.7	4.85	10.38

TABLE 4

CEILING-FLOOR NOISE REDUCTION AND COST CHARACTERISTICS

NOTE: T.L. - Average transmission loss (db.)
 C. - Cost in dollars per square foot of floor.
 E.C. - Effective cost in dollars per 100 square feet of wall per db transmission loss.

<u>Style</u>	<u>Floor Structure</u>	<u>Ceiling</u>	<u>Floor Finish</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
1	Wood Joists 2" x 8", 16" o.c.	7/8" Gypsum plaster on ex- panded metal lath.	13/16" subfloor and 13/16" oak finished floor	33	1.40	4.24
2.	Wood Joists 2" x 8", 16" o.c.	7/8" Gypsum plaster on wood lath.	Subfloor, 3/8" finished wood floor.	46	1.40	3.04
4	Wood Joists 2 x 8", 16" o.c.	7/8" Gypsum plaster on wood lath.	Subfloor, 1/2" fiberboard, 1" x 3" nailing strips, rough and finished wood floors.	58	2.20	3.79
7	Wood Joists Independent floor and ceiling joists with common bearing	1/2" Insulite plaster 1/2" fiberboard	Rough floor, 1/2" fiberboard Floating floor of 1" x 2" nailing strips, rough floor and 3/8" hardwood finished floor.	63	2.70	4.28
8	Combination Floor, 6" x 12" x 12" Clay tile 18" o.c. and 2" concrete slab above tile.	5/8" Brown coat and hard white plaster.	No finish	49	1.95	3.97

TABLE 4 (Cont'd.)

<u>Style</u>	<u>Floor Structure</u>	<u>Ceiling</u>	<u>Floor Finish</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
10	Combination Floor, 4" x 12" x 12" clay tile 17" o.c. and 2-1/2" concrete slab above tile.	2" x 13/16" furring strips 16" o.c., 1/2" wood fiber board and 1/2" gypsum brown coat and hard white plaster.	No finish	57	2.60	4.56
12	Combination Floor, 4" x 12" x 12" clay tile 17" o.c. and 2-1/2" concrete slab above tile.	2" x 13/16" furring strips 16" o.c., 1/2" wood fiber board and 1/2" gypsum brown coat and hard white plaster.	1"x2" nailing strips 16" o.c. 3/4" rough flooring and 3/8" oak finish floor plus 1/2" wood fiber board between concrete slab and nailing strips.	66	4.10	6.21
14	Combination Floor, 4" x 12" x 12" clay tile 18" o.c. and 2" concrete slab above tile.	1/2" gypsum brown coat and hard white plaster.	2" x 2" nailing strips, 16" o.c. 13/16" oak finish floor.	41	2.70	6.58
16.	Concrete flat slab 4" thick reinforced with No. 3 and rods 9" o.c.	13/16" x 2" furring strips 16" o.c., 1/2" wood fiberboard 1/2" gypsum plaster.	No finish	57	1.60	2.80
17	Concrete flat slab 4" thick reinforced with No. 3 and rods 9" o.c.	13/16" x 2" furring strips 16" o.c., 1/2" wood fiberboard 1/2" gypsum plaster.	Floating floor of 1"x2" nailing strips, 3/4" sub- floor and 3/8" oak finished floor.	60	2.50	4.13

TABLE 4 (Cont'd.)

<u>Style</u>	<u>Floor Structure</u>	<u>Ceiling</u>	<u>Floor Finish</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
19c	Concrete Slab 4" thick. Construction beneath slab. Special coiled spring stirrup hangers 24"x34" o.c., 1-1/2" furring channels 34" o.c., 3/4" channel crossfurring 16" o.c., 3/8" gypsum lath, 1/4" gypsum brown coat and 1/2" acoustical plaster (trowel finish). Insulation above lath varies.		Above lath: 3" ground cork.	54	3.10	5.74
701	Joists 2" x 8" 16+ o.c. Floor: 1" pine subfloor 1" pine finish floor. Ceiling: 1/2" fiberboard, 1/2" gypsum plaster.			45	1.90	4.22
702	Same as panel 701 except floor. Floor: 1" pine subfloor, 1/2" fiberboard, 1" x 3" sleepers 16" o.c.; 1" pine finish floor.			50	2.80	5.60
705	Same as panel 701 except ceiling. Added second ceiling of 2" x 2" wood joists, 16" o.c., 1/2" gypsum plaster. Second ceiling suspended 4" below original ceiling by screw eyes and wire loops 36" o.c., 2" x 5" x 5" fiberboard pads between second ceiling joists and original ceiling plaster.			56	3.40	6.07
706	Same as panel 702 except old ceiling removed, added 2" x 4" joists, 16" o.c., 1/2" fiberboard, 1/2" gypsum plaster (air space not be 10" dimension of 2" x 10" frame)			58	2.90	5.00
707	Joists 2" x 8", 16" o.c. Floor: 1" pine subfloor, 1" pine subfloor, 1" pine finish subfloor. Ceiling: 3/4" fiberboard.			40	1.70	4.25
710	Joists 2" x 10", 16" o.c. Floor: Pine subfloor, building paper, 13/16" pine finish floor. Ceiling: expanded metal lath held on 1/4" rods and spring clips 3/4" gypsum plaster.			51	1.40	2.74
180A	Joists 2" x 6" Floor: Wood subfloor, 2" x 2" sleepers, 16" o.c., hardwood finish floor. Ceiling: Expanded metal lath, 3/4" gypsum plaster.			38	1.60	4.21

TABLE 4 (Cont'd.)

<u>Style</u>	<u>Floor Structures</u>	<u>Ceiling</u>	<u>Floor Finish</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
711	2" x 10" wood joists 16" o.c., cross braces with 1" x 3" wooden bridging strips bisecting length of panel. On ceiling side 1/2" gypsum wallboard, joints filled and taped; on floor side 3/4" subflooring, rosin paper, and floating floor consisting of 1/2" x 2" fiberboard 16" o.c. trapezoidal sleepers (1-1/8" wide at top, 2" at bottom, 1-5/8" thick) 16" o.c., oak flooring.			37	2.10	5.67
715	2" x 8" wood joist, 16" o.c., 3/4" subfloor, building paper, and 3/4" tongue and groove fir finish floor; ceiling side 1/2" gypsum wallboard nailed to furring strips held by spring clips, the latter nailed to floor joists.			52	1.55	2.98
137	Open web 8" steel joists, 20+ o.c. Floor 3" thick wood-shaving board (portland-cement binder) clipped to joists, 1/2" concrete, 1/4" linoleum cemented to concrete. Ceiling: 1" thick wood-shaving board clipped to joists, 1/2" gypsum plaster.			53	2.40	4.52
804	Concrete slab, reinforced, 4" thick			47	.70	1.48
805	Same as above except 1" concrete made with asphalt-water emulsion added on floor side.			51	.80	1.56
802	Concrete slab, reinforced, 4" thick; 3/4" furring, expanded metal lath, and 7/8" gypsum plaster added on ceiling side; 3/32" mastic, 3/4" parquet floor.			49	2.35	4.74
B1	4.3" reinforced slab	0.4" plaster on soffit.	0.8" hard plaster	49	1.20	2.44
B4	4.3" reinforced concrete slab.	Separate wooden ceiling joists on the walls; lath, reeds and mortar.	0.8" hard plaster	55	1.50	2.72

TABLE 4 (Cont'd.)

<u>Style</u>	<u>Floor Structures</u>	<u>Ceiling</u>	<u>Floor Finish</u>	<u>T.L.</u>	<u>C</u>	<u>EC</u>
B5	4.3" reinforced concrete slab.	0.4" plaster on soffit.	Magne site tiles on layer of bitumen paper and Treetex.	50	1.20	2.40
B6	Prefabricated floor of 5.1" pumice concrete roof slabs with cassettes.		Hard plaster	42	1.20	2.85
B9	7" wood joists	Separate ceiling joists supported on the walls; lath, reeds, and mortar.	Boarded	46	1.55	3.36

TABLE 5

MODIFICATION OF EXISTING BASIC ONE FAMILY HOMES

Frame: Wood.
Window: Fixed - Resilient Mounted - 1/8" Glass.
Interior Walls: (Except Bath) NBS Panel 504 13/16" gypsum plaster on both sides with 3/8" gypsum core lath.
Floor Covering: Full carpeting all rooms except kitchen & baths where vinyl, asphalt or linoleum is used throughout.
Drapes: Heavy drapes for picture window and supporting wall; medium drapes in all other rooms except kitchen, where lightweight drapes prevail.
Interior Bath Walls: All baths have tile walls half way up. Remainder is NBS Panel 504.

<u>TYPE</u>	<u>Exterior Wall</u>	<u>Ceiling</u>	<u>Floor</u>
<u>CAPE COD (2 Levels)</u>			
Basic	Wood shingle all around with 1/2" gypsum plaster board on inside.	Top level: 1/2" gypsum plaster + 1-1/2" blanket insulation on 2'x8'-16" o.c. wood studs. First level: NBS 701 1/2" fiberboard + 1/2" gypsum plaster on 2'x8'-16" o.c. wood studs.	Upper level: 2'x8' on 16" o.c. 1" pine floor. 1st level: 2" pine on 2'x8'-16", o.c. studs.
Model #1	Same as Basic.	Same as Basic, but 2 bedrms. on top level use acoustic tile, type TMW cemented.	Same as Basic.
Model #2	Same as Basic.	Same basic ceiling but acoustical tile, type TMW cemented on all ceilings.	Same as Basic.

TABLE 5 (Cont'd.)

<u>TYPE</u>	<u>Exterior Wall</u>	<u>Ceiling</u>	<u>Floor</u>
Model #3	Same as Basic but with 4" brick veneer over entire front of house.	Same as Model #2.	Same as Basic.
<u>RANCH</u>			
Basic	Wood shingle on 3 sides, 1/2 of front with 4" brick veneer & remainder with wood shingles, inside 1/2" gypsum plaster board.	1/2" gypsum plaster & 4" insulation blanket on 2'x6'-16" o.c. wood studs.	2'x6' on 16" o.c. - 1" pine floor.
Model #1	Same as Basic.	Same Basic ceiling but with acoustical tile cemented - Type PRW - on all ceilings.	Same as Basic.
Model #2	Wood shingle on 3 sides, front side all 4" brick veneer.	Same as Model #1.	Same as Basic.
<u>COLONIAL</u> (2 levels)			
Basic	All Walls - wood shingle with 1/2" gypsum plaster on inside.	Top level: 1/2" gypsum plaster + 4" insulation on 2'x6'-16" o.c. wood studs. 1st level: 1/2" fiber-board, 1/2" gypsum plaster on 2'x6'-16" o.c. studs.	upper level: 2'x6' on 16" o.c. - 1" pine floor. lower level: 2" pine floor on 2'x6' on 16" o.c. wood studs.
Model #1	Same as Basic	Same basic ceilings on all levels except acoustical tile type PRW cemented on all bedrooms.	Same as Basic.

TABLE 5 (Cont'd.)

<u>TYPE</u>	<u>Exterior Wall</u>	<u>Ceiling</u>	<u>Floor</u>
Model #2	Same as Basic	Same basic ceiling on all levels with acoustic tile type PRW cemented in all rooms.	Same as Basic.
Model #3	3 sides same as basic but front side 100% 4" brick veneer.	Same as Model #2.	Same as Basic.
Model #4	4" brick veneer on all sides with 1/2" gypsum plaster on inside.	Same as Model #3.	Same as Basic.

TABLE 6

RESIDENTIAL STRUCTURES INVESTIGATED FOR NOISE REDUCTION & COST

The following constructions types are investigated for Cape Cod, Ranch and Colonial style buildings. See Figures 4 through 8 for floor plans.

All internal walls are Panel 504 of the National Bureau of Standards basic series; lower level floors are 1" pine, intermediate level floors are 2" pine; top floor ceilings are 1/2" gypsum plaster with insulation and wood studs, intermediate level ceilings are 1/2" fiberboard plus 1/2" gypsum plaster on wood studs; no sound transmitted through any ceilings.

<u>CONSTRUCTION TYPE</u>	<u>Walls</u>	<u>Windows</u>
A. <u>Wood Frame</u>		
1. Model #1	100% wood shingles with 1/2" gypsum board.	1/8" glass resilient mounted-fixed.
2. Model #2	50% wood shingles + 50% 4" brick veneer with 1/2" gypsum board.	1/4" double glaze-1/4" airspace resilient mounted.
3. Model #3	100% Brick veneer (4") with 1/2" gypsum board.	1/4" Dbl glaze - 1/2" airspace - resilient mounted.
4. Model #4	100% stone veneer (4") with 1/2" gypsum board.	1/4" Dbl Glaze - 1" air-space - resilient mounted.
B. <u>Varied Masonry Frames</u>		
1. Model #1	4" brick veneer on 8" solid concrete block with furring, lath and plaster.	1/4" Dbl Glaze 1" airspace resilient mounted.
2. Model #2.	4" stone (blue or sand) on 8" solid concrete block with furring, lath and plaster.	1/4" Dbl glaze-1" airspace resilient mounted.

TABLE 6 (Cont'd.)

<u>CONSTRUCTION TYPE</u>	<u>Walls</u>	<u>Windows</u>
C. <u>Double Wall</u>		
1. Model #1	4" brick veneer on 8" solid concrete block + 4" airspace + 8" solid concrete block with furring, lath and plaster.	1/4" Dbl glaze 1" airspace resilient mounted.
2. Model #2	Same as Model #1 but with 8" brick.	1/4" Dbl glaze 6" airspace resilient mounted.

TABLE 7

OFFICE BUILDING STRUCTURES INVESTIGATED FOR NOISE REDUCTION AND COST

-- STEEL FRAME --

<u>Basic</u>	<u>External- Internal Wall</u>	<u>Internal Wall</u>	<u>Window</u>	<u>Ceiling-Floor</u>
Single Wall	4" Precast Reinforced concrete modules with furring, lath and plaster inside walls.	NBS Panel 504 13/16" gypsum plaster on both sides of a 3/8" gypsum core - lath,	Double Glaze (1/4") 1/2" airspace-fixed resilient mounted.	Holland type structure #B-4 3/4" plaster type floor on 4-1/4" reinforced concrete slab-separate ceiling joists on walls with lath, reeds, and mortar with acoustical tile(cemented).
<hr/>				
<u>Model #1</u>				
Double Wall	4" precast reinforced concrete module + 4" air-space + 4" concrete module (precast) with furring, lath and plaster.	Same as Basic.	Double Glaze (1/4") 1"air-space fixed, resilient mounted.	Same as Basic.
<hr/>				
<u>Model #2</u>				
Double Wall	8" precast reinforced concrete module + 4" air-space + 8" concrete module (precast) with furring, lath and plaster.	Same as Basic.	Double Glaze (1/4") 6" air-space-fixed, resilient mounted.	Same as Basic.

See Figure 4 for floor plan.

COST OF INCREASING NOISE REDUCTION OF EXISTING RESIDENCES

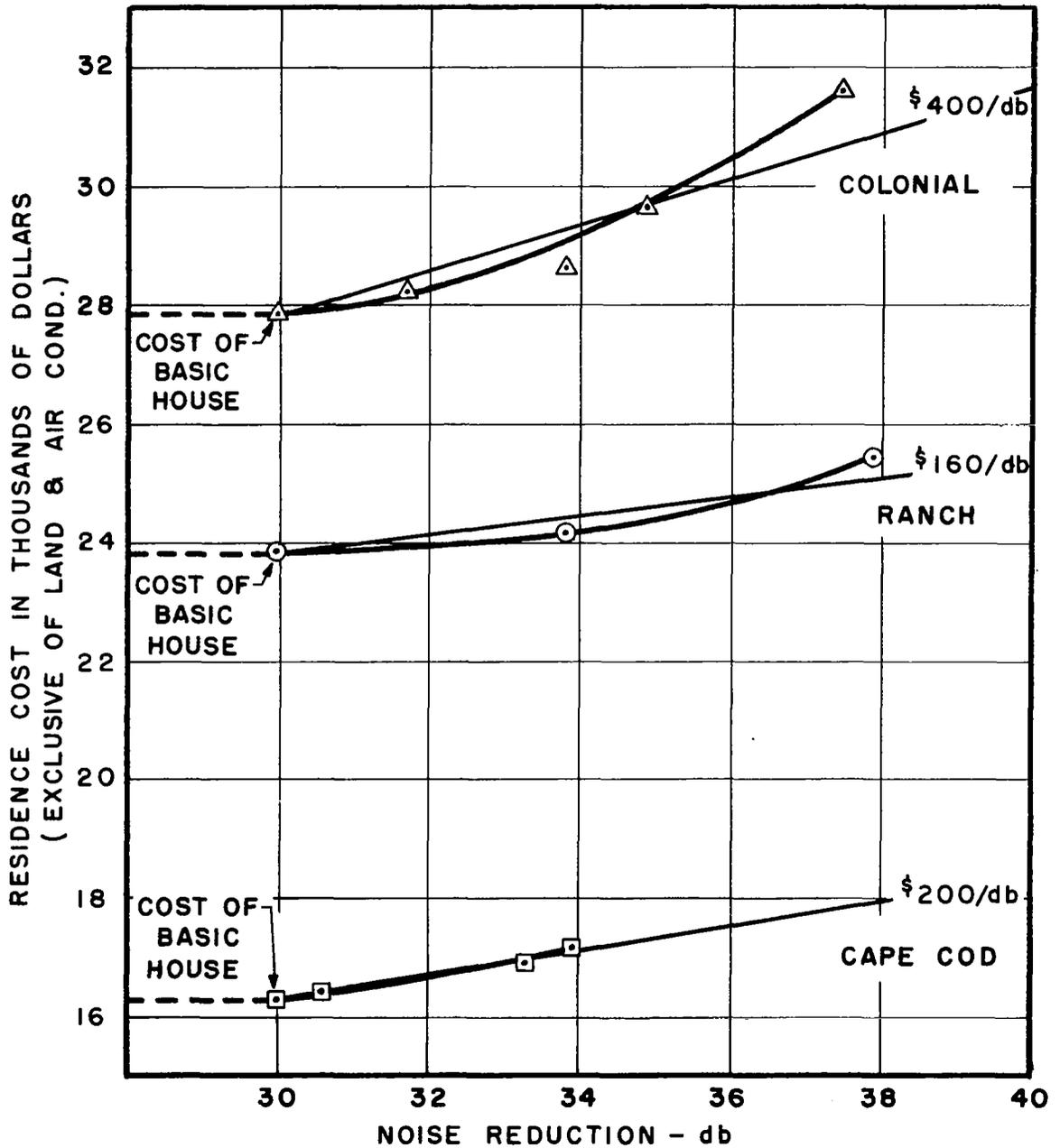


FIG. 1

GENERAL COST - NOISE LEVEL
CHARACTERISTICS FOR THREE
TYPICAL SINGLE FAMILY HOUSES

ABSORPTIVITY $\bar{\alpha} = .15$ AVERAGE
WINDOWS CLOSED

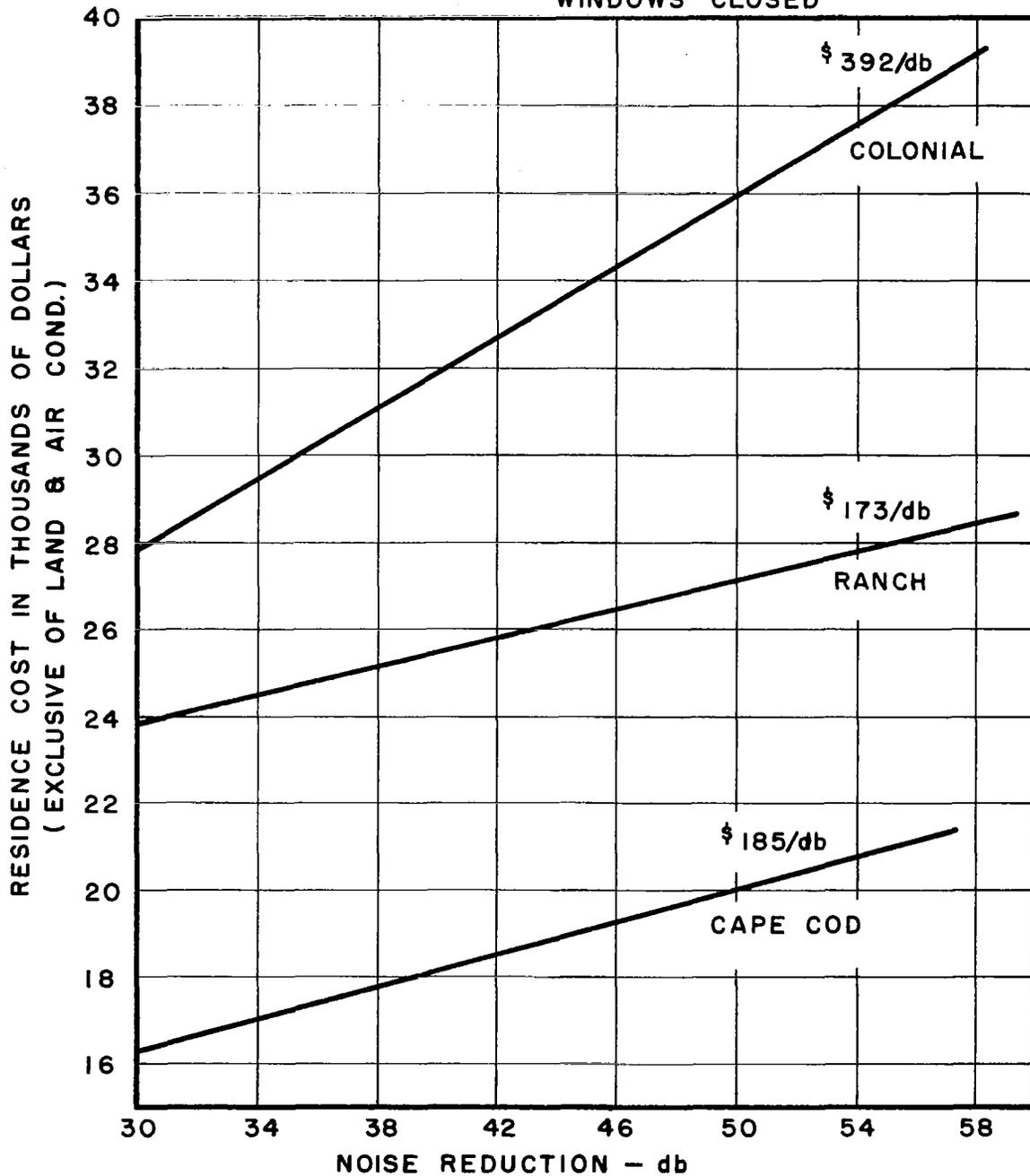


FIG. 2

GENERAL COST ACOUSTIC CHARACTERISTICS
OF A TYPICAL 5 STORY OFFICE BUILDING
30,000 SQ. FT. FLOOR AREA

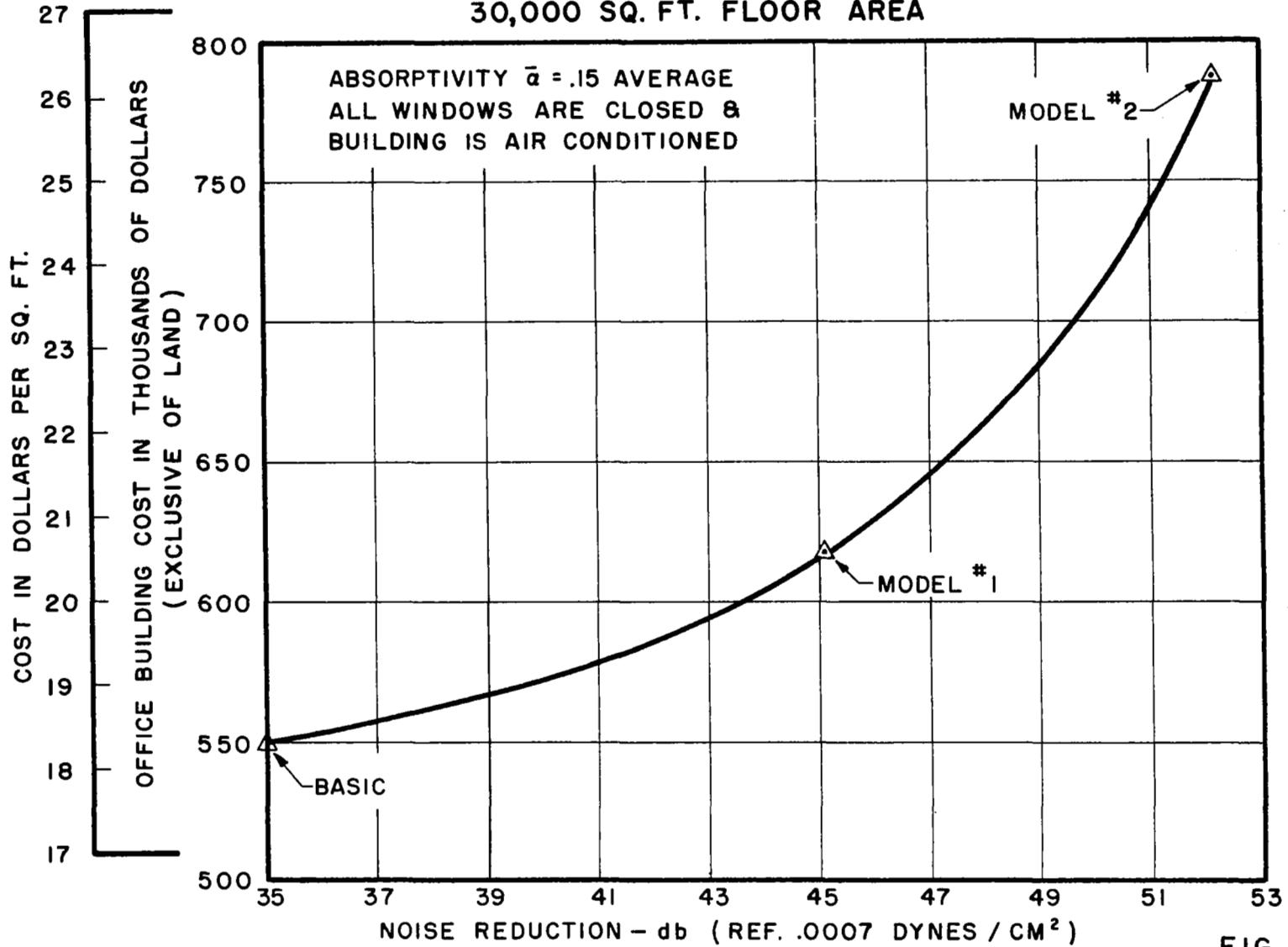
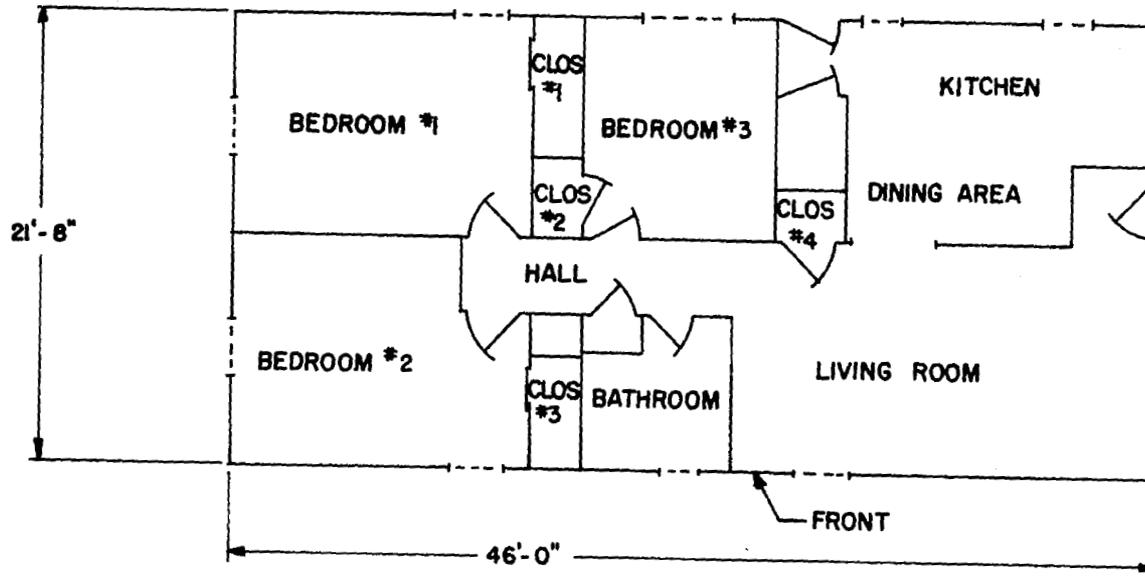
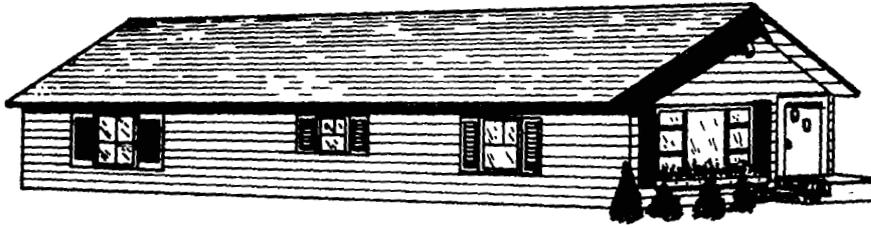
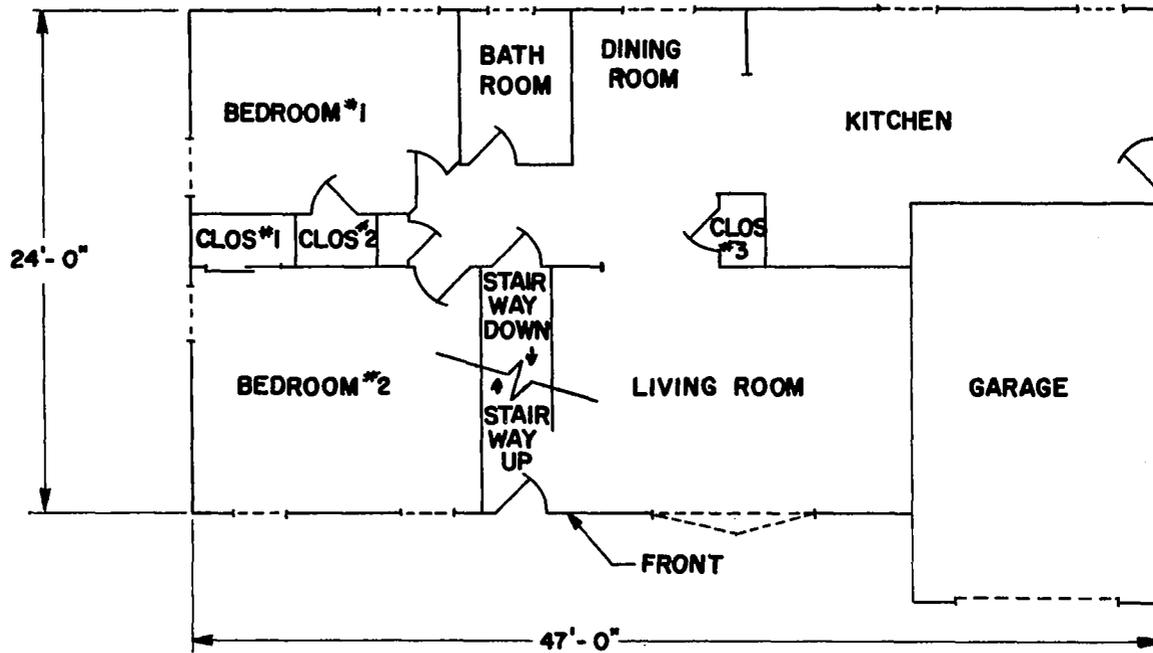
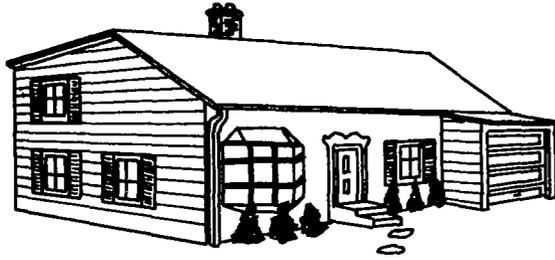


FIG. 3



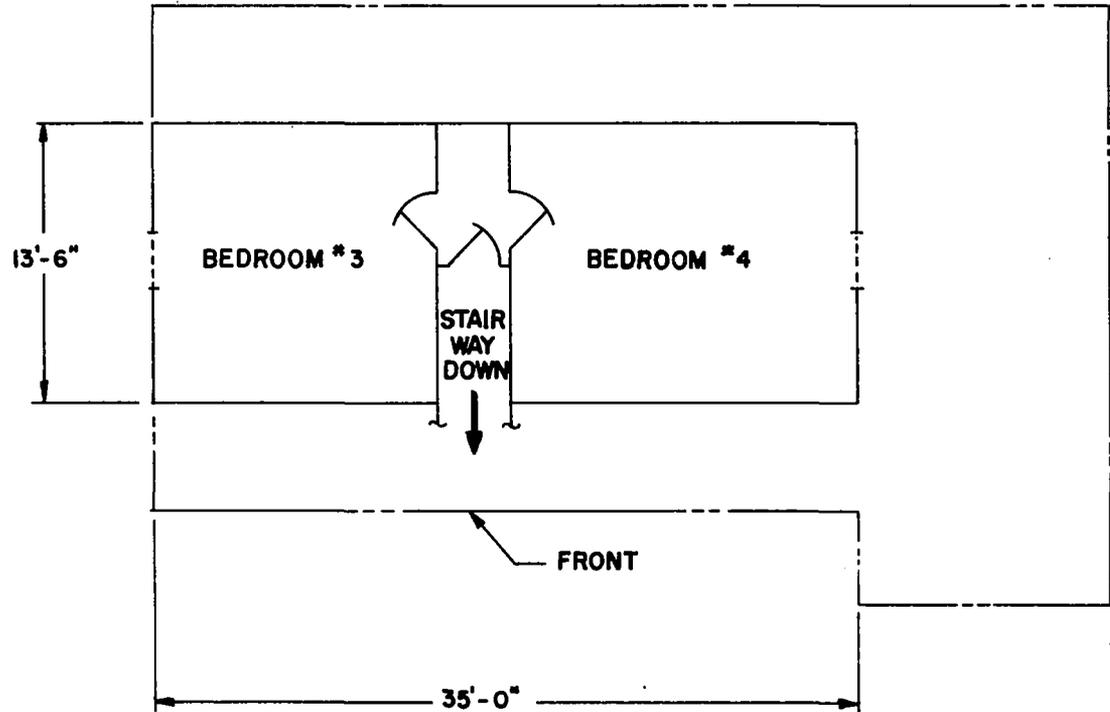
ROOM LAYOUT FOR TYP
RANCH HOUSE
SCALE - 1/4" = 1'-0"

FIG-4



ROOM LAYOUT FOR TYP
CAP CODE - FIRST FLOOR
SCALE: 1/4" = 1'-0"

FIG. 5



ROOM LAYOUT FOR TYP
CAPE COD - 2ND FLOOR
SCALE - 1/4" = 1'-0"

FIG. 6

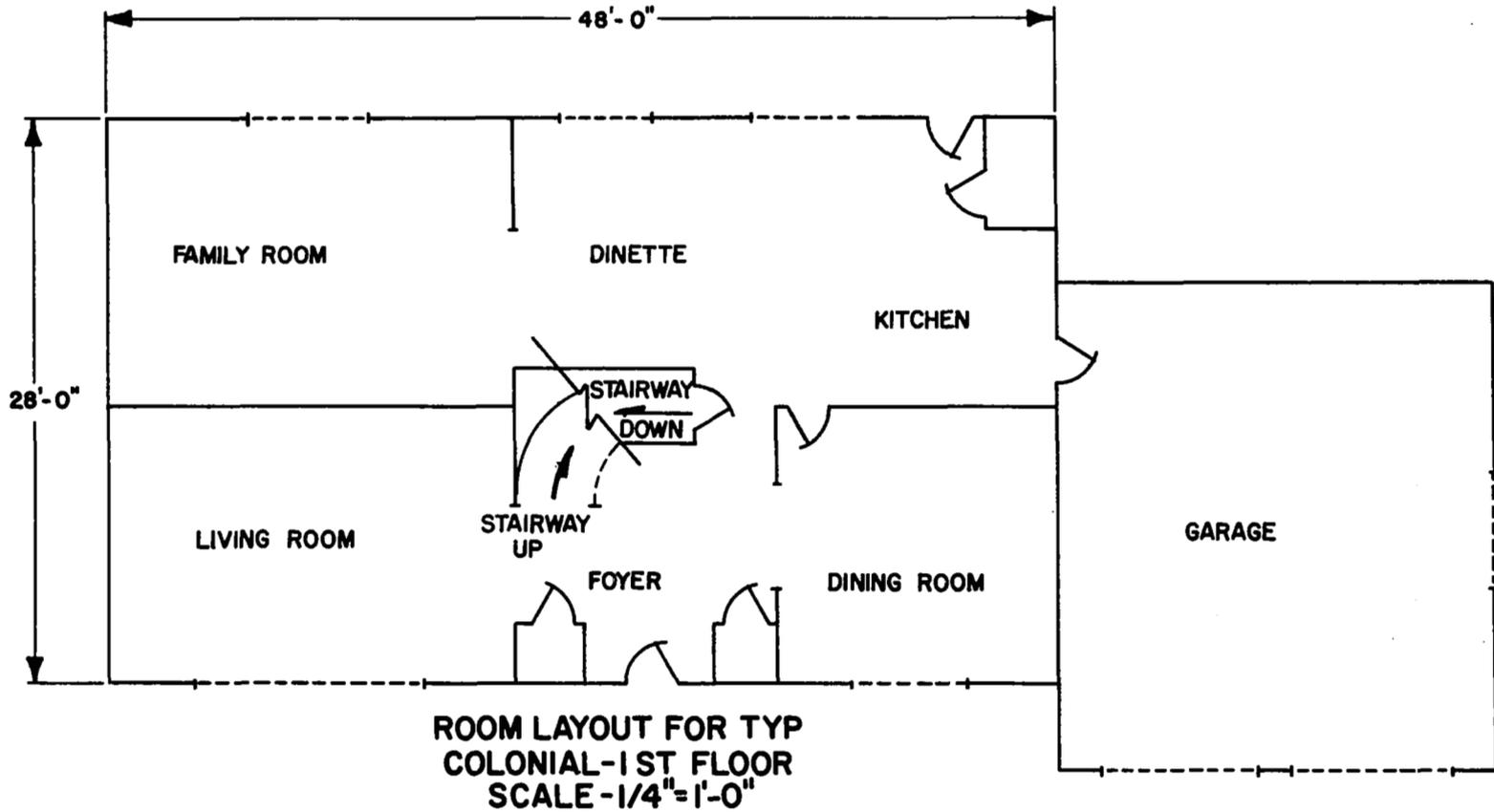
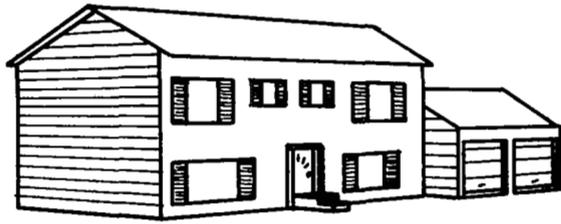
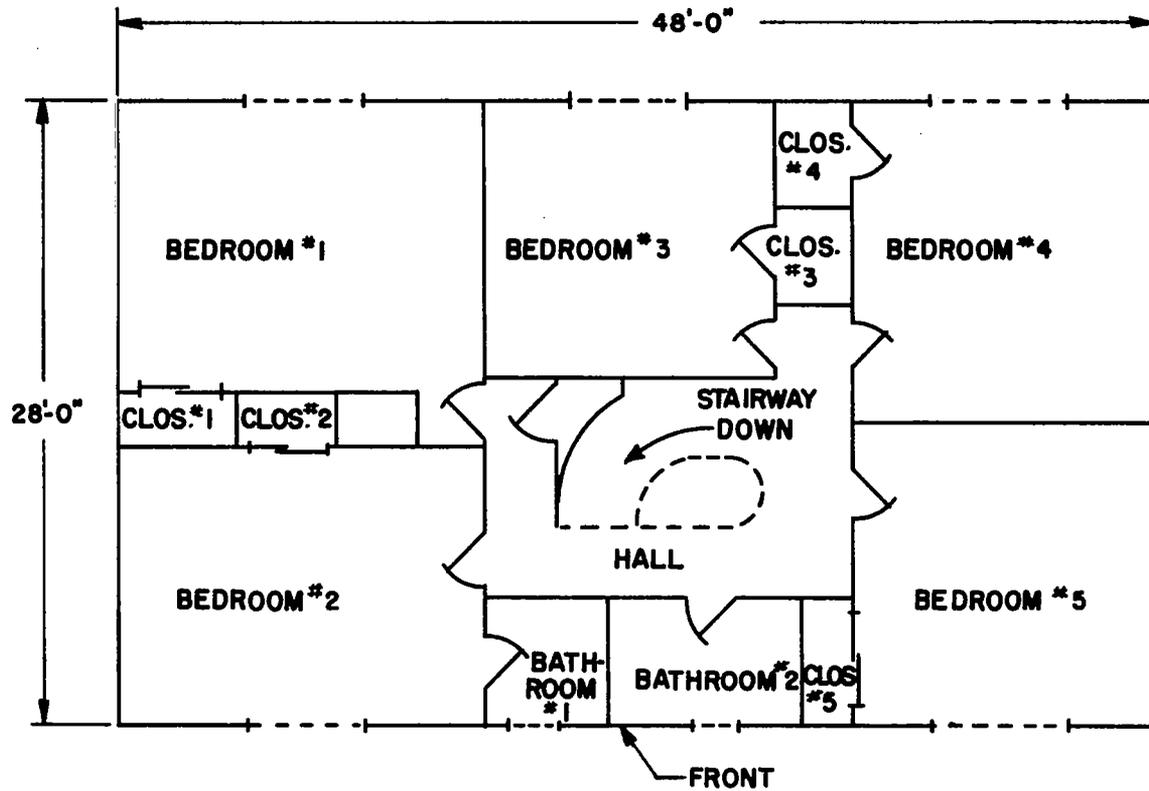
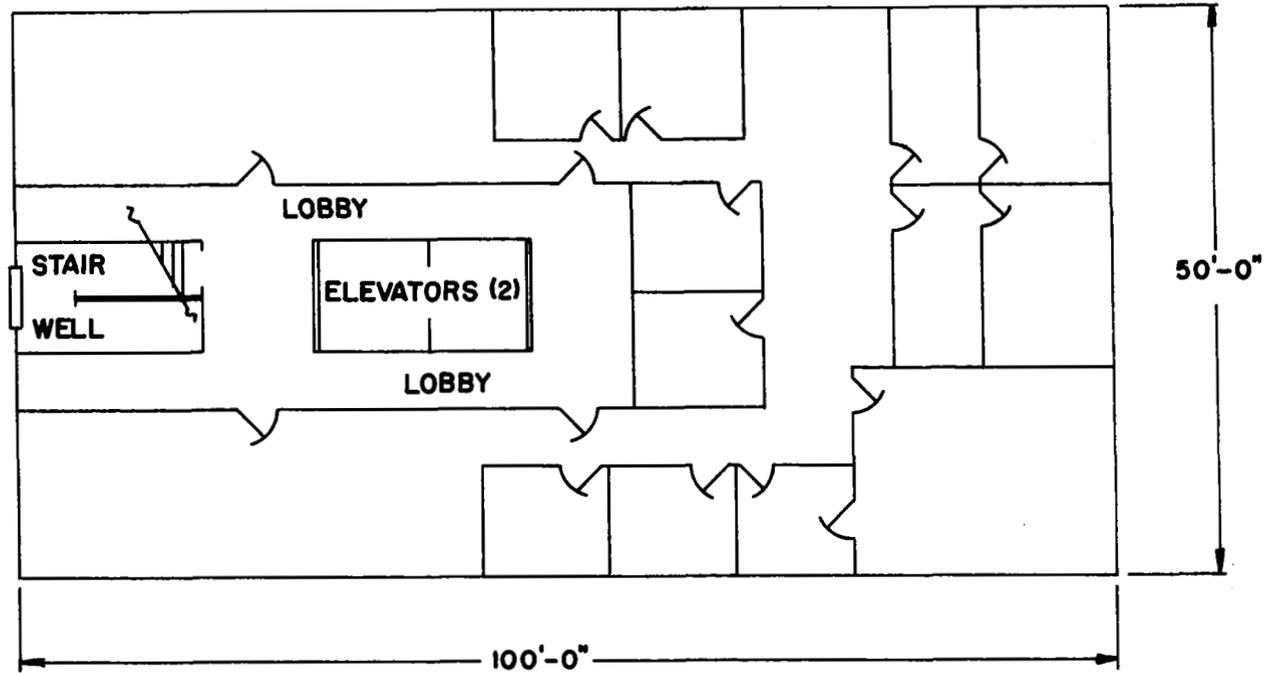
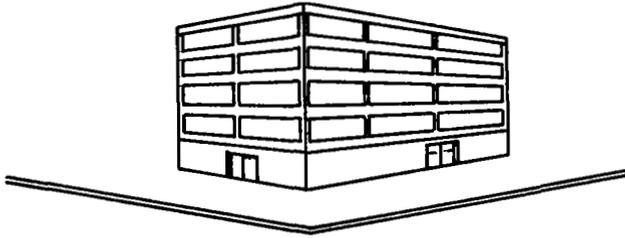


FIG. 7



ROOM LAYOUT FOR TYP.
 COLONIAL- 2ND FLOOR
 SCALE: 1/4"=1'-0"

FIG. 8



TYPICAL FLOOR SETUP
MULTISTORY OFFICE BUILDING
SCALE: 1/16"=1'-0"

FIG.9

J. DESIRABLE LAND USES FOR AIRPORT APPROACHES AND IN NOISE
AFFECTED AREAS

Desirable land uses near airports have one or more of the following characteristics:

- a. Land use involving few people such as reservoirs or sewage treatment plants.
- b. Uses which are inherently noisy so that aircraft noise has little additional impact, i.e., a printing plant.
- c. Indoor uses, commercial, industrial or institutional, which can be protected from aircraft noise by suitable soundproofing.
- d. Activities allied to the airport such as maintenance shops, truck depots, and warehouses.

Other examples of desirable land uses are listed below:¹

Natural-Corridor Uses

1. Rivers, lakes and streams
2. Swamps
3. Areas subject to flooding
4. Other forms of unpopulated land

Open-Land Uses

1. Cemeteries
2. Reservoirs
3. Reservations
4. Game preserves
5. Forests
6. Water-treatment plants
7. Sewage-disposal plants
8. Sod farming
9. Truck farming
10. Other vegetable and plant crop cultivation
11. Landscape nurseries
12. Golf courses
13. Riding academies
14. Picnic areas
15. Botanical gardens
16. Passive recreation areas

Industrial and Commercial

1. Aircraft and aircraft parts manufacturers
2. Air-freight terminals
3. Trucking terminals and other allied uses
4. Aviation schools
5. Aircraft-repair shops
6. Warehouses
7. Aerial survey and other similar companies
8. Aviation research and testing laboratories
9. Airline schools
10. Auto storage parts
11. Parking lots
12. Airport motels and hotels
13. Restaurants
14. Taxi and bus terminals
15. Wholesale distribution centers
16. Gas stations
17. Machine shops
18. Printing plants
19. Chemical processing plants
20. Food processing plants
21. Shoe factories
22. Apparel factories
23. General offices if suitably soundproofed.

APPLICATION OF LAND USE CONTROL TECHNIQUES TO A HYPOTHETICAL EXAMPLE

A demonstration of the use of the various powers and techniques available to local government is provided in the following hypothetical situation. The intent of this example is to show how the problem of aircraft noise in the vicinity of a major airport may be approached in a comprehensive manner. No particular course of action is recommended as applicable in all instances.

The conditions illustrated in the map and described in the text were created for the purpose of providing an example with a diversity of governmental arrangements, geographical relationships, land use patterns, and community situations. Any resemblance in whole or in part to actual conditions in any existing airport situation is entirely coincidental. Every element of the hypothetical situation can be changed at will to increase or decrease the complexity of the problem. All figures cited are illustrative, for the purpose of establishing the scale of the various factors and costs involved.

Numbers in parentheses refer to the page in this report on which may be found more detailed discussion relating to a mentioned topic.

BUSY CITY AND ENVIRONS

Busy City, located in Rolling County, is a metropolis of more than 250,000 population. It is the focus for finance, marketing, and distribution for a thriving region that includes rich agricultural areas as well as major industries whose products are shipped to all parts of the country and to other areas of the world. Beyond the city limits are several incorporated villages, some adjoining the city and others at some distance and physically separated by open land.

Two villages of immediate concern are Industry, which is adjacent to Busy City, and Progress, which is south of Industry but not contiguous to Industry or to Busy City. Both villages are on the main line railroad that enters Busy City from the southwest. Industry is an old manufacturing community with a belt of large and small plants along the railroad. Its inhabitants are employed primarily in the local plants, but some work in similar activities in Busy City. Development, both residential and non-residential, has occurred in such a manner that it is now virtually impossible to distinguish the village from the city at their common boundary.

Progress, on the other hand, is a residential community built on Pleasant Lake. Its residents take great pride in their community's appearance and in the high standards of municipal services provided by their taxes. They are employed primarily in the

professions or in executive or management positions in Busy City and Industry. It is considered the most desirable suburb of the several surrounding Busy City.

HISTORICAL DEVELOPMENT OF THE AIRPORT

The municipal airport at Busy City developed out of a private flying field established during the 1920's. It was acquired by the city in 1935 and soon became a very active airport. It is now operated by a City Airport Commission of three members. Located in the southwesterly corner of Busy City, adjacent to Industry, the airport has greatly expanded over the years. Its original site was enlarged during World War II in order to accommodate military aircraft being serviced or equipped by the several nearby factories that were converted to military production or that were built as part of the national defense effort.

Following the war, civil aviation expanded swiftly, and Busy City became a regional hub for airline passenger traffic. The major runways were extended to permit the operation of four-motor commercial airliners. Still another extension program was undertaken about 1959 to provide adequate runway length for the initial turbojet aircraft introduced into regular service. With the continuing growth of air traffic, general aviation aircraft have been encouraged to utilize other, smaller airport facilities in the vicinity of Busy City. However, the volume of passenger movements quickly outgrew the capacity of the original terminal building. The Airport Commission retained consultants to investigate the situation and to recommend an appropriate development plan and schedule for improving the airport.

Their recommendations include: construction of a new jet runway south of the existing main runway and parallel to it; extension of the existing diagonal runways, with one to serve as an active runway and the other to become a taxiway; relocation of the terminal area from the north side of the site to another site that will provide a more suitable relationship to the major runways and that will provide for a better connection to a proposed new express highway from the center of Busy City. The existing and proposed future conditions are illustrated on the accompanying map.

There are no immediate obstacles to the city's undertaking the improvement of the airport. It can acquire the needed additional land through the exercise of its power of eminent domain, both within the city limits and beyond its boundaries. The project has been approved by the Federal Aviation Agency and is included in the National Airport Plan. It is thus eligible to receive Federal funds for such purposes as: development of a general plan for the ultimate expansion of the airport; preparation of detailed engineering plans for runways, taxiways, drainage, lighting, and other features eligible for Federal support; acquisition of the necessary land for expansion; and for construction of these eligible facilities. The municipal share of the required funds, including the cost of the new terminal building, will be obtained through general purpose municipal bonds or through revenue bonds to be repaid from the rents and other income of the airport operation.

However, since the introduction of jet aircraft the owners and tenants of property in the vicinity of the airport have become increasingly irritated. Numerous complaints have been made concerning the noise generated by jets taking off or landing at the airport over parts of Busy City, Industry, and the unincorporated areas beyond the existing runways. A local noise abatement committee has publicized the efforts made by the aircraft industry in modifying aircraft power plants to reduce the amount of noise generated, and the results of studies made by the regional representatives of the Federal agencies, the airlines and their pilots, and the airport manager with regard to modification of the takeoff and approach patterns in order to reduce the area exposed to aircraft noise. Most of the people living and working in the areas affected by the existing runways had become accustomed to the noise of piston engines, but reacted sharply to the different characteristics of jet noise. In addition, the expansion program would expose to aircraft noise several areas that had not been affected previously, including the Village of Progress and the parts of Busy City and unincorporated Rolling County in line with the new runway.

One result of the studies has been a suggestion that a system of preferred runways be established. In view of the prevailing winds at the airport and the fact that the heavier new aircraft can take off and land in cross winds, it is feasible to make all landings from the east or northeast, and all takeoffs to the west or southwest.

The Airport Commission has issued an attractive brochure to demonstrate the need for expansion, pointing out the jobs, income, and other economic benefits that will accrue to the entire region. Neighborhood groups in Busy City, however, have joined forces in opposition to the program, suggesting that the facility be removed to another part of the region. The nearby villages affected by the airport program have been critical of the lack of regard displayed by Busy City to its smaller neighbors, while the business and civic leaders in the city and the county are concerned with the lack of sensitivity of the smaller municipalities to the over-riding needs of the entire region that are carried on the shoulders of Busy City alone.

CREATION OF A STUDY COMMITTEE

Sensing a need to discuss the entire problem of airport development on a more objective basis, the Rolling County Civic Council organized an ad hoc committee comprising representatives of all levels of government, leaders of major business and civic organizations and institutions, and professionals, to examine the circumstances and make recommendations for appropriate public and private action. The committee's findings with respect to the airport locations and the ways and means of creating compatibility between the airport and its environment are presented in the following pages.

The committee found that the present location of the airport has great validity in the regional pattern of land use and circulation. Although other areas offer open land, they are at a great distance from the city, and would require a large investment in public highways and other modes of transportation. Further, the committee found that investment in plants and facilities by the private sector of the economy, over and above the capital

investment of the airlines, as represented by the hangars and other installations that are essential parts of an airport, was very great in the vicinity of the airport, was directly related to the airport's operations, and would suffer if the airport were to be physically relocated. Changing the surface transportation system to provide for the movement of people and goods between airport related activities and homes or markets would also entail considerable expenditure, and would be accompanied by a disruption in travel patterns during a change from one location to another. Therefore, the committee decided that the public and private investment at the existing airport, plus the availability of land for the expansion at that site, outweighed the anticipated cost of developing a completely new airport at a greater distance from the city, and its report vindicated the proposed expansion program.

The committee did not stop at that point in its deliberations, however. It next reviewed the relationship of the proposed airport program to the development patterns of the surrounding area and determined that extensive areas would be affected by the noise of turbine powered aircraft landing and taking off from both the new and the extended runways. The committee proceeded, therefore, to explore quickly the ways and means of affecting compatibility between existing and possible future land uses and the airport activity.

CURRENT PLANNING EFFORTS: BUSY CITY

Busy City has an active planning department whose primary concern is with city functions. Its staff is aware of the municipalities adjacent to the city, and regularly attempts to coordinate planning and zoning matters of mutual interest at the city limits. There is no formal machinery for this purpose, however, since the state laws do not require inter-municipal referral of planning and zoning matters.(32) Further, while the Village of Progress has an active planning board which has adopted a Master Plan and a zoning ordinance, neither the Village of Industry nor Rolling County have planning agencies. Industry has an old zoning ordinance, but the county has none. The city and all the villages operate under a state-wide building code. (36) Only Busy City has established an urban renewal agency; its primary interest has been with the deteriorating areas adjacent to the central business district. (45)

The Master Plan of Busy City was prepared at the end of World War II in order to guide postwar development. However, it is now quite out of date and the planning staff is undertaking the initial surveys of a new program to bring the plan up to current standards and requirements. Among other important reasons, this plan is needed to satisfy the requirements of the Workable Program for Community Improvement in order for the city to qualify for continued Federal assistance in public housing, urban renewal, and other activities. (11) While the original Master Plan included provision for the airport, it did not anticipate the extraordinary growth of air travel that would require expansion of the facility to the extent now under consideration. Nor was it concerned with the problems of aircraft noise, nor of ensuring a pattern of development around the airport that would be compatible with its operations. The south and west boundaries of the airport were the city limits, while the area to the north was developed with enterprises related to the

airport and to the aircraft industry. The area to the east was relatively open and undeveloped at the time of the Master Plan. The city's zoning ordinance was based on the old Master Plan and does not reflect the presence of the airport either in terms of population density or in terms of land use types permitted under the existing approaches to the airport.

The city's planning and zoning do not extend beyond the municipal boundary. (29, 33) The city adopted an airport zoning regulation at the time of the last previous extension of the major runway. It is effective only within the city limits. Neither the county nor any of the nearby municipalities complied with a request that they enact similar controls to protect that portion of the airport approaches within their respective jurisdictions. (35)

CURRENT PLANNING EFFORTS: VILLAGES AND COUNTY

Although the Village of Industry has no planning board, it does have a zoning ordinance adopted more than thirty years ago. Most of the land in the vicinity of the airport is in an unrestricted district, in which there is virtually no control over the type, density, or bulk of the land uses. The Village of Progress, on the other hand, has an active planning board, as has been previously stated. Its new Master Plan and zoning ordinance are in line with current trends in planning and zoning, including exclusive zoning for various kinds of uses. However, the Village considered only its own territory in its planning and zoning, with little thought concerning possible activities outside its boundaries that might affect its pattern of development. Since it is primarily a residential community, with the area near the lake zoned for and developed with one family houses on lots of one-quarter acre or more, the village governing body saw no reason to enact airport zoning regulations, because no structure higher than 35 feet is permitted under the zoning ordinance.

Rolling County is experiencing increasing pressure for development in the unincorporated areas outside the city and villages. A county study committee is currently considering the idea of establishing a planning commission and adopting a county zoning ordinance. Under state law, however, the jurisdiction of a county with respect to planning and zoning is limited to the unincorporated territory, and cannot affect municipalities except insofar as the county constructs highways and/or public buildings. All property assessment is conducted at the county level, however, as the public schools are provided on a county-wide basis, with the ad valorem property tax as the major financial support.

COORDINATION OF PLANNING EFFORTS

As one result of the fragmented nature of the planning and zoning efforts in the vicinity of the airport, the committee found it necessary to review the ways and means of coordinating those activities on an area-wide basis. (19) Several possibilities were considered, including the following:

- a. The encouragement of each jurisdiction to set up its own planning agency, with a voluntary agreement to coordinate planning and zoning matters across their respective boundaries;

- b. The creation of an area-wide planning agency with its own staff to act in an advisory capacity in the coordination of local planning and zoning, with support in the form of contributions from the several jurisdictions in the county;
- c. A transfer of planning and zoning powers to the proposed county planning agency, or else the assignment to it of responsibility for coordinating local planning and zoning matters;
- d. The establishment of an independent regional planning agency supported by a minimal tax levy on the entire county, to conduct research and to prepare reports and proposals for the development of the entire county regardless of municipal boundaries;
- e. The creation of a special airport district to plan, develop, and operate all the airports required to provide adequate service for general aviation as well as air carriers, with the special responsibility for recommending a pattern of compatible land uses to the jurisdictions affected by its operations; (24)
- f. The consolidation of the city with the county and village governments in such a fashion that area-wide functions can be performed in a more efficient manner, while retaining the identity of individual community areas and limited home rule powers.

The committee was impressed by the need for an agency that could bring together for impartial study the various area-wide or multi-jurisdictional problems and that could represent the entire area in discussions with State and Federal agencies. Thus land use and development could be better related to the construction of a transportation system, including highways as well as airports, and public utilities and facilities such as water, sanitation, and schools could be coordinated with other programs on an overall, rather than a piece-meal basis. In addition, under such an arrangement, it would be feasible to maintain adequate home rule powers for local planning and zoning on a detailed area basis within a general framework covering the entire county area.

The committee considered the desirability of removing the responsibility for airport development and operation from the municipal level, where it remains the prerogative and financial responsibility of a single city, to a level at which its regional economic function could be recognized and its interjurisdictional impact could be assessed more realistically, in a manner similar to that in which major highway improvements are assessed by a state highway department.

Regardless of whether an airport were to be located in an urban or a rural area, the committee recognized that it would be impossible to preserve the existing environment. The acquisition of huge tracts of land to "insulate" the airport would itself create certain kinds of change, as would the presence of the airport. Hence, consideration was given to the various means available to different levels of government for planning and for developing land use patterns that in the long run would be compatible with the airport environment.

Within certain limits, Rolling County and each of its constituent municipalities has the power to plan and zone. Once the conditions of aircraft noise are established and the approach areas to be protected are identified, land that is undeveloped or used for an extensive activity such as agriculture can be regulated; the planning and zoning powers can then be used to induce or control the kind and intensity of compatible uses permitted in such areas, and airport zoning can control the height of possible safety hazards. Such an ideal situation is seldom encountered, however. In the current case only scattered vacant lots exist under the runway approaches in Busy City, in Industry, and in the unincorporated area between the two villages. The lake front area in Progress is completely developed with houses of good quality; the northwesterly portion of the lake is bordered by a large tract in single ownership and is relatively undeveloped, while the land immediately south of the airport is also largely undeveloped and is used for growing shrubs, plants, and trees by a nursery. Scattered commercial development exists along both sides of South Road, with few houses. Garden apartments and small house subdivisions have begun to fill in the southerly area of Busy City and to creep across the city limits into unincorporated territory.

In the undeveloped areas, it would matter very little which of a list of many compatible uses were to be permitted in any given municipality, so long as the zoning were enforced and the land kept in the relatively open condition. In developed areas, on the other hand, zoning by itself is of little benefit unless there is some means to eliminate non-compatible existing uses that do not conform to the revised zoning regulations. Since the authority for completely removing non-conforming uses from a municipality is not specifically granted in the state enabling legislation, it is usually necessary to resort to other devices in developed areas, including the following: (30, 46)

- a. Purchase of the full fee to the property, which is followed by clearance where the permitted height under airport zoning is so restricted as to preclude any reasonable use;
- b. Purchase of the full fee, as above, with relocation of an existing structure to another site where it would be a permitted use, and with retention by the original owner or resale to a third party;
- c. Acquisition of a limited public interest in a property, such as an aviation easement or development rights, by negotiated purchase or by condemnation. Where negotiation is possible, the original owner would retain primary ownership and would be compensated for the rights acquired. Where negotiation is not feasible, a specific limited right may be condemned, or the entire rights of the property may be condemned (with just compensation to the owner) and the property sold to another subject to deed restrictions or easements to effect the public purpose;
- d. Encouragement of owners or tenants to modify structures to bring them closer to compatibility with the noise environment, through special loan and/or grant programs, reduction of assessments, direct abatement of property taxes, or other financial relief.

The first of these several devices (the outright acquisition of the full fee) must be used to acquire clear zones and sites for special installations such as radio beacons and landing lights, in addition to the land specifically required for airport sites. The clear zones are intended primarily to eliminate obstructions above the elevation of the runway so as to permit aircraft to take off or land at a minimum angle when required by load or weather conditions. Properties beyond this clear zone that are seriously affected by aircraft noise might be subject to the taking of limited rights or an easement, or to the modification of the structure.

INVESTIGATION OF CONDITIONS

In order to obtain a better understanding of the nature and extent of the noise and land use problems to be resolved, the committee studied the characteristics of many affected areas, the applicability of the various remedies, and the relative cost of these remedies. The areas studied are indicated by numerals on the map, and run clock-wise around the airport starting to the south.

AREA 1

The first area consists of the relatively undeveloped land between the airport and South Road in the unincorporated territory of Rolling County. Its 350 acres are utilized primarily for horticultural purposes, as previously described. Although the terrain falls away from the airport, the area is roughly parallel to Runway D. It is exposed to higher noise levels at the westerly end, from takeoff operations on Runway B. With Runway D used for landings from the east, the 100 PNdb contour falls along the airport perimeter. For takeoffs to the west, the area is exposed to between 100 and 110 PNdb after the aircraft leaves the ground, roughly half the length of the runway. From the point of view of the airport, it is desirable to prevent further development in this area.

Possible Remedies: Since the land is currently in an extensive open space use, and apparently providing a satisfactory return to the owners, it appears to be suitable for exclusive agricultural zoning. (31) In this area, county action is required. That would entail the establishment of a county planning agency and the enactment of suitable zoning regulations conforming to a land use plan. (21) Further, in order to justify and support such zoning, the county must be prepared to establish an assessment policy under which land in such uses would be assessed at a reasonable rate. If the assessed values were to reflect the pressures of the open market for such land, they could not hold out against development in the face of the higher taxes they would be expected to pay if they were assessed as building lots instead of agricultural acreage.

Commercial uses along the highway would be relatively unaffected by aircraft noise. The noise level of a shopping center averages 55 decibels, while the environment of a busy main road averages about 70 db. The noise generated by an aircraft taking off is estimated to be 100 PNdb along the edge of the right of way. This would be attenuated by ordinary construction to about 70 PNdb, which is only slightly higher than the highway noise. If the commercial uses are air conditioned as is customary for business premises

currently, and doors and windows are kept closed, the noise level in any commercial use should be acceptable without additional modification. The only area that would be subjected to higher noise levels would be toward the westerly edge, where aircraft taking off from Runway B could generate a slightly higher noise level. Residential structures near the highway and already exposed to the high noise environment of fast moving or heavy vehicles, would probably not require additional acoustic treatment either.

Cost Factors: In this area there would be no appreciable public cost. Any diminution in possible tax revenue from the land is offset by the absence of a need for public services and facilities.

AREA 2

The second area is a tract of about 125 acres in single ownership to the northeast of Pleasant Lake in unincorporated territory of Rolling County. Over the years this parcel has become a quasi-public recreation area used by organizations for group outings on payment of a small fee to the owner. Most of the site is subjected to noise levels of 100 PNdb or more which emanates from aircraft taking off from Runway B. It would be desirable to keep this land in an open space use and to prevent any development that would be in conflict with the noise environment.

Possible Remedies: Since the parcel is already in an open space use of a quasi-public nature, it would be feasible to acquire it or to dedicate it to such a use permanently. Several alternatives are apparent:

- a. The owner may dedicate it to a public open space use, possibly retaining a life tenancy of the property.
- b. A public agency may acquire the property by negotiation or condemnation for public park purposes. If negotiated, it would again be possible to provide for lifetime tenancy by the present owner. (47)
- c. A public agency may acquire a limited interest in the property, such as rights to further development or an avigation easement, in return for a direct payment as compensation or a limited tax abatement. (47)
- d. The county may zone it for an open space use, as in agricultural zoning. However, in this instance, such zoning does not appear to be reasonable, since the property is not producing a reasonable return, as contrasted with the situation in Area 1. (31)

Cost Factors: The price of keeping this property in a compatible use ranges from no cost at all to the full fee at market value. If the land is given to a public agency or otherwise dedicated to public use, there is no initial cost of acquisition. If purchased or condemned by a public agency, the market price would be required as compensation. On the other hand, if it were to be acquired by an agency charged with the development of

parks and recreation on a metropolitan or regional basis, it would be possible to obtain a Federal grant of 30 per cent of the cost under the Open Space Land Program. (15) If no such agency exists, it would still be possible for the county or one of its municipalities to apply for Federal assistance in acquiring the property; such a grant would be limited to 20 per cent of the purchase price.

AREA 3

Almost all of the Village of Progress is affected by takeoff operations on Runway B. Some 3,000 houses in this high quality residential community are exposed to noise levels of 100 PNdb and more. The village is almost completely developed, and there is little or no opportunity for new construction. The houses average \$30,000 in market value. The current zoning is limited to 4 families per net acre near the lake, and 8 families per net acre further to the west.

Possible Remedies: Operational changes on the part of pilots can produce little improvement in the situation. Vectoring aircraft to the south or west after takeoff would merely expose other areas of the community to varying degrees of disturbance.

The average residence will attenuate exterior noise by 30 db. Further, in an existing structure it is feasible to further reduce noise penetration by 10 db without major reconstruction. In an area exposed to 100 PNdb, therefore, it should be possible to reduce the exterior noise by 40 PNdb, or to a level of 60. This is still a noisy environment for a residence, but it is possible to live with it. In new construction it would be feasible to dampen noise penetration to a greater degree but at considerable cost.

In areas exposed to more than 110 PNdb, it may be desirable to be prepared to acquire every residential property from its current owner, impose an avigation easement, and sell the property on the open market, with the difference in price, if any, to be considered as the cost of the easement. If the Village of Progress maintains its former reputation as a very high quality community, the houses will probably sustain a high market value despite the dampening effect of aircraft noise.

Cost Factors: Modification of 2550 houses @ \$3000 aggregates to \$ 7,650,000; purchase of 450 houses exposed to 110 PNdb+ @ \$30,000 aggregates to \$13,500,000. At a lower cost, it would be feasible to acquire the 450 houses, impose an avigation easement on each deed, and re-sell the houses for close to the purchase price.

AREA 4

This is a developed area in unincorporated county territory between the two villages. It consists primarily of single family house subdivisions built right up to the end of the clear zone, though at a lower elevation than the runway. Extensive commercial development has occurred along West Road. The density of development is approximately 10 dwellings per acre. The average value of houses is \$20,000. The construction of Runway D has intruded aircraft noise into an area not previously subjected to it. Some 2,000

houses are exposed to noise levels of 100 ~ 110 PNdb and half that number are subjected to noise of 110 PNdb and more. The terrain falls away quickly beyond the runway, and the noise impact of aircraft on takeoff is very sudden. Under the circumstances it would be desirable to remove all residences east of West Road and to prevent further development that would tend to increase the population density in the affected areas.

Possible Remedies: To prevent further dense development, a zoning ordinance must be adopted by the county, as described above under Area 1. Unless the owners would be satisfied to sell avigation easements, it would be necessary to acquire and clear some 50 acres of houses. West of the highway, it would be sufficient to provide additional acoustic modification, but a considerable number of residents would probably prefer to sell their houses and move elsewhere in the region. In such cases it would be advantageous to acquire avigation easements under the procedures previously described. A minimum of treatment would be necessary for the commercial uses.

Cost Factors: It would cost in the neighborhood of \$10,000,000 to acquire all the residences affected by the sudden impact of takeoff noise. Only a relatively small part could be covered by Federal grants for additional clear zone. This cost should be recouped in some manner for the public benefit. Since it involves a stream valley, the area might be utilized for a park or other public purpose. However no new use should be permitted that would tend to attract large numbers of people at one time.

Modification of the remaining 3,000 houses would aggregate some \$6,000,000 at an average investment of 10 per cent of the value of each house. This would improve the interior noise environment to a reasonable level. In the commercial area where there is already a relatively high noise level, an investment of \$500,000 (at \$ 5 per square foot for 100,000 square feet of space) will accomplish the desired results of reducing overhead aircraft noise to a tolerable level.

AREA 5

This area involves a major portion of the Village of Industry, developed with older one and two family houses, averaging \$15,000 in value, with a density approximating 20 families per acre. The problem close to the end of Runway A is not so severe as in Area 4, since there is a belt of industrial development along the railroad. Still, almost 200 acres of old houses are subject to noise amounting to 110 PNdb and higher, and an area twice the extent is exposed to 100 to 110 PNdb. There are small groups of neighborhood shops, usually in clusters with apartments above. There are old schools and churches that antedate the airport. There are the beginnings of privately sponsored re-development in the area, with houses being remodelled and converted to apartments.

Possible Remedies: The zoning ordinance of the Village should be revised and brought up to date. A housing code is needed to guide conversions; the building code already available should be amended to include provisions for acoustical control. (36)

Modification of the 4,000 houses exposed to high noise levels would help to make them more livable. Many people in the poorer area of the Village will be content to continue living in their house without making any changes. A major effort would be required to acquaint them with the possible acoustic improvements and the ways of accomplishing them. As an alternative, it might be feasible to establish as a public policy the redevelopment of part of the area between the industrial section and the highway with uses that are more compatible with noise. Such a program would require a major planning effort on the part of the Village. Schools and churches pose different kinds of problems. It would be desirable to remove them from close association with the noisy area. Some of this could be accomplished through urban renewal or through capital programming to replace old buildings, with new ones in better locations. It is not very difficult to modify school buildings with air conditioning and other technological improvements. Churches and other places of public assembly present a harder problem because they are usually related to particular segments of the community and often have financial problems.

Cost Factors: The cost of basic planning efforts can be supported in part by Federal grants for such municipal programs. Urban renewal project planning is carried on under Federal advances provided against a total project budget. Therefore the initial investment in such activities can be fairly light.

There would be a direct municipal cost for inspectors and administrators of zoning, housing, and buildings codes, but individual property owners would not have to be compensated for improving their properties.

Modification of 4,000 houses at \$1,500 each would aggregate \$6,000,000 whereas total acquisition and clearances of the area would cost ten times that amount. Under urban renewal programs it would be possible for the Village to recoup part or all of its investment over a period of time. However the magnitude of the project in this instance would appear to place it beyond the immediate capacity of the municipality to undertake. The 8,000 additional dwellings further from the high noise area would require another \$6,000,000 on the basis that not all the residents would avail themselves of the program nor would they improve their properties to the same extent.

AREA 6

This is an industrial area in the Village of Industry and in Busy City. The portion within the village is exposed to very high noise levels of takeoffs at the end of Runway A, while much of the industrial area in Busy City is subjected only to the relatively lower level of noise generated by aircraft landing on Runway B. Most of the structures in Industry are below the level of the airport; neither the railroad nor many of the one story industrial buildings or warehouses along the railroad is seriously affected by the noise of aircraft operations. Many of the plants have a high level of interior noise, while the warehouses are occupied by a very small number of people. Offices and commercial uses in the affected area are customarily separated from industrial and warehouse uses, and would be air conditioned and otherwise better protected against the intrusion of aircraft noise.

Possible Remedies: In obtaining the required clear zone at the westerly end of Runway A, it will be necessary to acquire and demolish some structures as part of the airport expansion program itself. In Busy City, the landing pattern occurs along the edge of the industrial district, and the actual noise is of a different character. Most of the industries already have a high interior noise environment and would not be affected by 100 PNdb of aircraft noise overhead, particularly if the industrial structures of themselves provide for a partial attenuation of exterior noise. The office portions of such buildings may require some acoustical modification, however, if they are not already protected against noise of contiguous plant operations. In any program of redevelopment, caution should be taken to maintain the compatibility of proposed re-uses.

Cost Factors: In the industrial districts related to the airport, there is no appreciable cost element required for inducing a compatible noise environment except for administrative offices.

AREA 7

The older portion of Busy City's residential area related to the industrial district is subjected primarily to the noise of landing patterns under the system of preferential runway use. Essentially, this results in long, narrow areas exposed to noise of overflight. Two areas are affected, one by landings on Runway B, and the other by landings on Runway A. In the former case, the area is very close to and affected by the old industrial district of the city. The area is generally blighted and ready for redevelopment. There are approximately 80 acres in this area with 2,000 dwellings whose average value is about \$7,500. The area under the approach to Runway A, on the other hand, has maintained a fairly stable character. In connection with the airport expansion program plans are being prepared for a major expressway that will cut through the area as it approaches the airport terminal connection. Approximately 40 acres of good residences will be removed by the highway project within the noise zone. These properties average \$12,500 in value.

Possible Remedies: In the first area, under the approaches to Runway B, the city's proposals for future redevelopment hold out the opportunity to induce compatible land use patterns over a relatively short period of time. Whether accomplished through a General Neighborhood Renewal Program or individual projects, this area can be transformed into one that is related to the industrial and airport environment, hence more productive. (11) In the second area, under the approaches to Runway A, it may be desirable for the city to acquire either the full fee or avigation easements east of the East Road, in order to eliminate the noisiest problem area. Such a program could involve some 4,000 structures in an area under too great a noise level to permit adequate modification. Commercial uses close to the airport, such as motels and restaurants, are dependent on the airport for their primary business.

Cost Factors: In the first area there are very few structures worth further investment into acoustical improvement. In the second, the cost of acquiring the full fee to the properties between East Road and the proposed expressway would be approximately \$50,000,000. A part of the area would be taken for the ramp connections indicated between the two major

highways. It might be possible to redesign the highway elements so as to require greater takings in the affected area, sparing the developed area immediately to the south that is not so severely affected by aircraft noise as it is by the cutting through of the highway right-of-way. East of the proposed highway right-of-way it would be feasible to introduce the program for modifying individual houses to reduce the transmission of jet noise. In the 350 acres, containing approximately 5,600 houses, the cost of such a project would be as much as \$7,000,000.

AREA 8

The area of the city east of the new Runway D is relatively new, containing garden apartments and single family houses with an average value of \$20,000. The area closest to the end of the clear zone is protected by the highway interchange and the width of East Road. Approximately 800 acres of developed land lie under the approach pattern and are subjected to noise levels of 100 PNdb or greater. Only a part of this area close to East Road is fully developed. The balance has not yet been subdivided.

Possible Remedies: Changes in the density permitted under zoning would help to prevent the development of new housing with a concentration of population under the approach area. Similarly, changes in the building and housing codes of Busy City would require suitable acoustic protection of residents of the area. For those already living in the area, modification of their houses and apartment buildings appears to be a partial solution. In the westerly portion of the area, where the concentration of noise is greatest, it may be necessary to acquire avigation easements or to obtain full fee ownership in order to clear our structures that cannot be made compatible with the noise environment.

Cost Factors: Approximately 3,000 houses would have to be modified, at an expense of \$6,000,000 or more. Two apartment units are estimated to be the equivalent of one house in this area, insofar as the cost calculation is concerned. The cost of total acquisition in the 100 acres under the most extreme noise would be approximately \$32,000,000. A major portion of this might be recouped through the redevelopment of the area fronting on the main highway within easy reach of the airport terminal to offices, motels, and other uses related to the airport activity.

SUMMARY OF THE COMMITTEE'S FINDINGS

The airport should remain in its present location. An effort should be made to reduce the sensitivity of surrounding development to the airport noise.

This can be accomplished in a variety of ways.

A system of preferential runways for take offs and landings will limit the extent of the noise-affected areas.

There are a few undeveloped areas which can be maintained in open or low density use compatible to the airport environment. Such land uses can be maintained without cost to the public by zoning.

In developed areas exposed to less than 100 PNdb, the noise reduction accomplished by ordinary construction is sufficient to create an acceptable interior noise environment. No public action is necessary.

In developed areas exposed to between 100 and 110 PNdb, an acceptable interior noise environment may be obtained by adding about 10 db of extra noise reduction to the existing buildings. Some 18,000 homes around the Busy City Municipal Airport are exposed to such noise levels. The cost of modifying these structures to the minimum degree necessary would approximate \$39 million.

In areas exposed to more than 110 PNdb, a similar effort would not be sufficient to produce a satisfactory interior noise environment. In such areas payments for the acquisition of avigation easements might be made large enough to provide the average homeowner with sufficient funds to effect the greater structural modifications required. However, the magnitude of the payments would approach the full value of the property. In such a case, it might be more satisfactory to acquire the full fee. The aggregate of such an acquisition program, affecting some 7,000 houses in the immediate vicinity of the airport, would be more than \$100 million.

There are several large areas in which urban renewal can play a major role in effecting changes to more compatible land use patterns. While houses in these areas are subject to the same modification procedures, they were not included in the calculations because it is assumed that they will give way to other, more suitable development.

It is unreasonable to expect that over the long run purely cooperative intergovernmental measures will resolve the problems posed by the airport's activities. The various governments - county, city, and village - do not operate at equivalent levels. While there may be equal concern evidenced by local authorities, they are affected to different degrees; their respective community needs and resources also vary greatly.

An agency should be established that will represent all elements of the region - the county, the city, the villages, and the unincorporated area - for conducting effective planning on a total area basis and for coordinating local zoning. This would be advisory in nature to all municipalities; it would not be a super-government. Its support would be from the general county tax levied on all jurisdictions, so it would not be dependent on annual appropriations from individual municipalities. Such an agency would be qualified to apply for and receive state and Federal assistance for regional planning, community renewal, and other programs.

An agency should be established to develop, maintain, and operate a regional system of airports, including the Busy City Municipal Airport. It could be a special district with a broadly based tax as its primary support, supplemented by operating revenues. Such an agency could be assigned the responsibility for other regional functions, such as parks and recreation, water, refuse disposal, and sanitation. It would be in a position to conduct programs of financial assistance for individual property owners as well as for municipalities affected by its activities, and it would be able to acquire full or limited rights in real property. While it could be combined with the regional planning operation described above, such an operating agency could be kept separate, but with a continuing and close functional relationship to the planning activity.

GLOSSARY

AD VALOREM TAX

A tax levied as a rate per cent upon the stated or assessed value of specified items, such as real property.

AIRPORT ZONING

The regulation of the height of structures in areas adjacent to airports.

AVIGATION EASEMENT

A legal document permitting the operation of aircraft over property, in return for reasonable compensation.

BUILDING CODE

Minimum standards of construction required to be met within the jurisdiction of the regulatory authority.

CAPITAL PROGRAM

A long-term plan for financing major capital improvements such as streets, parks or buildings.

CLEAR ZONE

An area beyond the end of a runway, under control of the airport operator, in which the height of structures is controlled to permit a minimum angle of flight for take off and landing operations.

COMPOSITE NOISE RATING (CNR)

Perceived noise in decibels corrected for operational factors such as frequency of landings and take offs, runway utilization, and time of day. (See Page 52 Paragraph H this report.)

CONDEMNATION

The legal process by which the public acquires property and other rights for public use, through the exercise of the power of eminent domain.

DECIBEL (db)

A unit for measuring the relative loudness of sounds on a scale beginning with 1 for the faintest audible sound.

DEDICATION

An appropriation or a giving up of land or of specific rights in land to public use, made by the owner and accepted for such use by the public.

DEED

A document used to transfer the full or partial fee in land from one party to another.

DEVELOPMENT RIGHT

A legally valid claim to construct improvements upon the surface of a specified area of land.

EASEMENT

An acquired privilege or right of use or enjoyment, falling short of full ownership, which one person may have in the land of another.

EMINENT DOMAIN

The sovereign power of government over property which enables the public to appropriate private property or rights therein for public use with or without the owner's consent, but with reasonable compensation to the owner.

FEE

The full collection of ownership rights which are held in perpetuity in a particular parcel of land or property.

HOME RULE

The ability of local government to make its own decisions relative to local affairs.

HOUSING CODE

Minimum standards dealing with the occupancy, minimum facilities, and maintenance of existing structures used as residences, required to be met within the jurisdiction of the regulatory authority.

INTEREST

A right, title, share or participation in land or property.

LIFE TENANCY

A right in property which ordinarily extends for the lifetime of its owner. As used herein, the right of an owner of land or property which is given, sold, or condemned for public use to occupy such property for the balance of his natural life.

MASTER PLAN, OR COMPREHENSIVE DEVELOPMENT PLAN

A written text or maps, or both, indicating developmental goals to be achieved over a period of time, and generally relating to patterns of land use, circulation, community facilities and the financial and administrative devices for executing the plan.

NOISE LEVEL

Same as sound level.

NOISE REDUCTION

In decibels the difference between the sound level outside an enclosure and the resulting sound level inside the enclosure.

PERCEIVED NOISE LEVEL (PNdb)

In decibels, the sound pressure level of noise in the 910-1090 cps range which would sound as noisy for the average person as the given noise (Ref.: "Noise Reduction" - L. Beranek - McGraw-Hill Book Company, 1960, Page 515, Paragraph 20.1). In practise the perceived noise level is determined by weighting the sound pressure levels of the component frequencies in accordance with the procedure given on Page 532 of the preceding reference.

RESTRICTION

A provision in a deed which regulates certain uses of the land or property to which the deed pertains.

RIGHT

A legally valid claim to specified control over the use of land or property for a given period of time.

SOUND ABSORPTION COEFFICIENT

The ratio of the sound energy absorbed by a surface to the sound energy incident on the surface.

SOUND LEVEL

In decibels, the weighted sound pressure level obtained by assigning different weights to the component frequencies of a sound, as defined by the American Standards Association Standard S 1.4-1961.

SOUND PRESSURE LEVEL

In decibels twenty times the logarithm to the base 10 of the ratio of the sound pressure to a reference pressure of 2×10^{-10} atmosphere.

SPECIAL DISTRICT

A unit of government created to perform a specific function such as water supply, sewage collection and treatment, etc.

TRANSMISSION LOSS

In decibels the difference between the sound energy randomly incident on one side of a partition and the sound energy emerging from the other side.

URBAN RENEWAL

A combination of devices, such as conservation, rehabilitation, and clearance and redevelopment, utilized to eliminate and/or prevent deterioration of urban areas.

WORKABLE PROGRAM FOR COMMUNITY DEVELOPMENT

A series of municipal actions having as their common goal the improvement of environmental and social conditions in a community, required by the U.S. Housing and Home Finance Agency of municipalities participating in certain Federal programs.

ZONING

The employment of the police power of the state to regulate the use of land, the height and bulk of buildings, the proportion of the lot that may be covered, and the density of population.

AN OUTLINE OF LEGAL PRECEDENTS

The courts of the fifty states and the Federal government have built up a tremendous body of case law with respect to land use controls and with airport problems. A number of cases have been selected, some of major significance and others typical of many decisions, to illustrate the development of the legal precedents upon which the major elements of this study are based. They are listed below in chronological order.

- 1926 *VILLAGE OF EUCLID v. AMBLER REALTY COMPANY* (272 US 365; 47 S Ct. 114)
Established the basic constitutionality of municipal zoning laws based on the police power;
- 1938 *ARVERNE BAY CONSTRUCTION COMPANY v. THATCHER* (278 NY 222; 15 NE 2d 587)
Emphasized that zoning must be reasonably related to current conditions and trends; specifically, it held that the strict enforcement of a zoning regulation that does not result in the creation of the desired pattern of development over a reasonable period of time might constitute a taking of property rights without due compensation.
- 1943 *MURRAY v. LA GUARDIA* (291 NY 320; 52 NE 2d 884)
Upheld the use of eminent domain and tax abatement to further a public purpose (in support of redevelopment by private agencies).
- 1946 *UNITED STATES v. CAUSBY* (328 US 256)
Established that navigable airspace is in the public domain and not subject to private ownership or control; at the same time, the court held that an owner of land owns at least as much of the airspace over his property as he can reasonably occupy or use, hence frequent overflight at low level might constitute a taking of property rights for which an easement should be required, with compensation to the owner.
- 1949 *DUFFCON CONCRETE PRODUCTS v. BOROUGH OF CRESSKILL* (1 NJ 509; 64 A 2d 347)
Accepted regional considerations as a basis for a municipal zoning ordinance excluding specific uses, and emphasized the language of the enabling legislation that requires municipalities to be concerned with development beyond their immediate boundaries.
- 1952 *FISCHER v. BEDMINSTER TOWNSHIP* (11 NJ 194; 93 A 2d 378)
Upheld the principle of large lot residential zoning (in this case, 5 acres per residence)
- 1953 *LIONSHEAD LAKE INC. v. TOWNSHIP OF WAYNE* (10 NJ 165; 89 A 2d 693; 344 US 919)
Upheld the right of a municipality to require, as part of its zoning ordinance, a minimum habitable floor area for residences, with a range of area related to the type of structure.

1954 **BOROUGH OF CRESSKILL v. BOROUGH OF DUMONT** (15 NJ 238; 104 A 2d 441)
Citing the Duffcon case (see above), the court held that comprehensive planning requires municipal officials to consider conditions in adjoining municipalities as they relate to zoning within the municipality.

BERMAN v. PARKER (348 US 26; 75 Sup Ct 98)

Sustained the constitutionality of Federal urban renewal legislation and of the use of eminent domain to acquire private property for public purposes in instances where the property is re-sold to others for redevelopment in accordance with an over-all plan.

1955 **ALLEGHENY AIRLINES v. VILLAGE OF CEDARHURST** (132 F Supp 871)

Held that the needs and interests of the larger regional community were superior to those of a single municipality, in voiding a municipal ordinance prohibiting all air flights at elevations less than 1,000 over the village, which is close to a major international airport.

1962 **GRIGGS v. COUNTY OF ALLEGHENY** (369 US 84)

In a decision based on the Causby case (see above), the court clearly assigned to the airport developer or operator the burden of acquiring easements in connection with the approaches to an airport, thus relieving the Federal government and the airlines of the responsibility.

1963 **INDIANA TOLL ROAD COMMISSION v. JANKOVICH** (193 NE 2d 237)

Voided as an unconstitutional taking of property without due compensation a municipal airport zoning ordinance that imposed severe restrictions on the use of land under the approaches to an airport. In effect, the court states that where a height limitation is so severe as to deny an individual the reasonable use of his land, the full or partial fee should be acquired.

1964 **MARTIN ET AL v. PORT OF SEATTLE** (391 P 2d 540)

Under the Constitution of the State of Washington, which provides for compensation to the owners of property "taken" or "damaged", the court held, among other matters, that properties affected by the noise of landing and takeoff operations need not be precisely under the path of flight to be eligible for relief; further, where the owners of property sue for compensation for rights that have been taken by the result of public action (termed an action for "inverse condemnation") the court held that compensation must be based solely on the decline in market value of the property.

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